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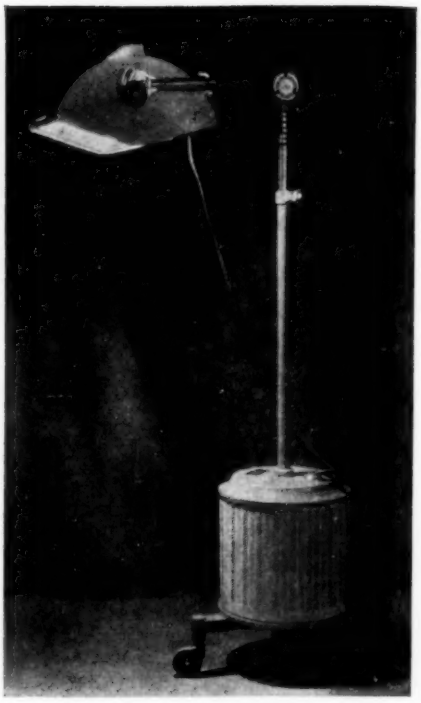

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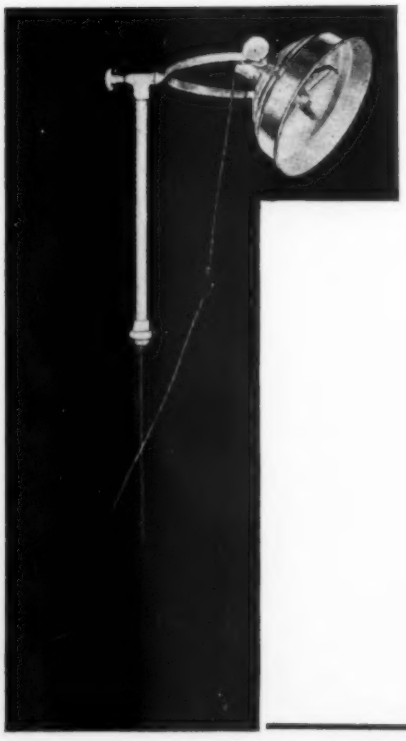

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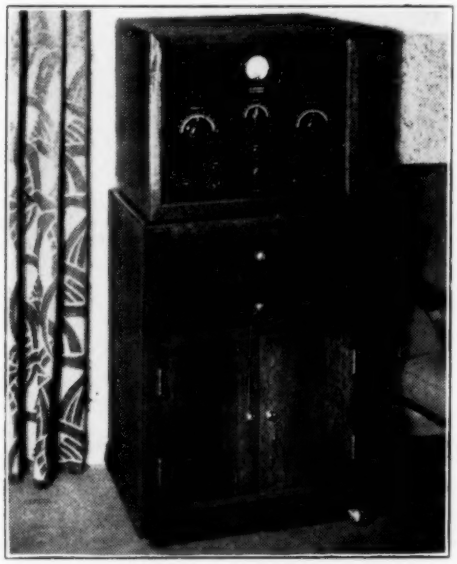

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RADIOTHERAPY COMBINED WITH DIATHERMY AND GALVANIZATION IN INFANTILE PARALYSIS

(Bordier Method)

PROFESSOR HENRY BORDIER

Corresponding Member of the French Academy of Medicine

LYON, FRANCE

Acute anterior poliomyelitis, or Heine's disease, is the result of an infection by a filtrable virus, whose localization at the level of the cord is favored by an hereditary neuropathic predisposition. After the inflammatory fever stage certain groups of muscles appear to be affected by paralysis, and this paralysis after some spontaneous regressions, remains definitive. The extremities that remain paralyzed present a temperature lower than that of the healthy side, the arterioles are narrowed and there often is cyanosis. One sees even today adults who were attacked in their infancy, in various degrees of infirmity — muscular impotence more or less complete in extremities or segments of extremities, pendulous extremities, muscular atrophy, arrest of growth, and various trophic disturbances.

General Considerations

The prognosis of infantile paralysis is far from being as grave and as despairing as was once believed. The therapeutic results of modern procedures and particularly of the method which I have published in 1921[1] show that infantile paralysis can be if not cured in all cases, at least changed into a much less grave affection from the standpoint of function, and into one without entailing incurable infirmity or crippling.

Some authors who evidently have failed to recognize the advances made, contend that if the prognosis of infantile paralysis is different from that of the past, it is due to the circumstance that the disease has changed, and above all that there has been included under the name of infantile paralysis various types of infectious poliomyelitis, not excepting those which clinically resemble the neuritides while others present the appearance of some form of meningitis. It is very easy to reply to such a contention and to establish facts. One thing is incontestable, and that is that the painful as well as the meningeal types have become frequent at present where in the past they have been very rare.

Up to the last few years the entire electric treatment of infantile paralysis was restricted to the constant (galvanic) current, and we all know how meager the results of this single form of treatment were. In 1911, after experiments with medullary radiotherapy,[2] I was the first to make use of the application of x-rays for progressive muscular atrophy, which, as is known, is due to *chronic* anterior poliomyelitis. The patient who today, after 24 years, is in excellent health, has not only experienced arrest of the progress of the poliomyelitis but restoration of some of the affected muscles both in function and in size. This was a case affecting the biceps and the deltoid muscles, which had been attacked.

I was naturally induced to try this same treatment in infantile poliomyelitis, and I have become impressed with the efficacy of this method. I have since added diathermy to the radiation, both in the acute and the chronic form of poliomyelitis. Diathermy was given not only to heat the atrophied, cold muscles but also to afford better nutrition to all tissues of the paralyzed extremities. To the two agencies — radiotherapy and diathermy — I added galvanization of the mass of paralyzed muscles after their temperature had been restored nearly to normal by the diathermic treatments.

Technical Considerations

Let us examine the three electrotherapeutic methods employed in the treatment of infantile paralysis.

1. *Radiotherapy.* X-rays possess the property of favoring resorption of inflammation of the cells of the affected anterior horns and of restricting, directly or indirectly, the destructive process of the motor cells of the spinal cord. Radiotherapy, in hastening resolution of the inflammatory stage, improves the circulation and places the motor cells in a

better condition of defense. The inflammatory process is accompanied by an edematous infiltration and the appearance of adjacent connective tissue cells. By employing radiotherapy immediately after the febrile period of poliomyelitis, one has the most favorable conditions to influence the edematous infiltration, the exudate and the newly formed connective cells. Under proper dosage of the x-rays the nerve cells are completely or partially freed of the destructive process. Another result of radiotherapy that must be considered is the stimulating action of the rays on nerve cells that have not been completely destroyed. Debedat, of Bordeaux, in connection with a case of infantile paralysis that was remarkably influenced by this treatment, asserts that there exists a special affinity of the x-rays for connective cells in their evolutionary stage (law of Bergonié — Triboudeau) while normal elements are inaccessible, even while they are in a stage of evolution.

In old paralysis in which cicatricial and sclerous tissue has formed at the level of the attacked cells, these are subject to a compression, a sort of asphyxia, which the x-rays sometimes can cause to be diminished, more or less freeing the cells which primarily suffered from the edematous infiltration.

Radiation therapy should be resorted to as early as possible and in all cases before the lesions have become definitive. One must bear in mind the topographic relations between the emerging roots and the spinal apophyses for the cervical as well as lumbar swelling. The rays must be directed obliquely and not vertically (the patient lying on the abdomen) in a manner to enter the cord across the vertebral lamina which are least thick and not across the spinal apophyses.

Radiation, as I apply it, is performed in a series of three consecutive seances, each series at a middle dose at the level of the skin and under an aluminum filter of 6 mm. of about 800 units R. For very young infants a dose of 500 to 800 R. suffices. The doses must be stronger if the poliomyelitis has taken place a longer time ago.

In many of the small children I have noted nausea and occasionally vomiting after the second or third irradiation. It is well to advise the parents about this possibility. Finally, for children under 7 years, it is wise to make use of a retention appliance with a belt to prevent the patient from moving.

2. *Diathermy.* The second therapeutic indication is to combat the hypothermy of the atrophied muscles, for one can easily appreciate the nutritional changes in an affected extremity by a lowered temperature, and the arrest of development of its muscles and tissues by absence of heat. Inversely, one can also easily realize that if one can produce in an affected extremity a virtually normal temperature, the nutritive metabolism will not fall behind that of the normal side, and during the growth of the little patient the affected extremity may develop approximately the same as the corresponding one. That is precisely what one does not see take place in patients condemned to wear orthopedic appliances or who are given faradization by some technician without adequate training in medical electricity.

Without doubt the most effective agent to restore the temperature in a cold extremity is diathermy. The cold of a group of muscles is harmful not only with regard to trophic metabolism, but to the action of treatment by electricity proper — galvanization or sinusoidal voltaization. The electric reactions of a cold muscle are as a matter of fact much different from those of the same muscle when it is warm. Hypothermy compels us to accept the existence of a reaction of degeneration, while after diathermization the electric reactions may be normal.[3]

The technic of diathermy in infantile paralysis is as follows: If we have to deal with a lower extremity, the foot or the feet of the patient are placed on a thin (0.1 mm.) sheet of tin foil resting on a soft cushion while another metallic electrode is placed under the buttocks. The intensity may be raised to 600, 800 or even 1,000 milliamperes according to the age of the patient. One must test with one's hand the rise in temperature in the limb above the malleoli. The current must be stopped when the child begins to complain of pain in that part of the limb.[4]

To convey an idea of the efficacy of diathermy, I present some figures I have obtained, (Table 1.) which shows a rise of 7 degrees C.

For the arm the technic is somewhat more delicate. One may lean the hand on a metallic plate while the other electrode is placed on the back, but when the little patient

TABLE 1. — *Temperature Rise Obtained With Diathermy*

Region	Temperature Before	Temperature After 30 Minutes
Dorsal aspect of the foot	25.5° C.	32.4° C.
Inferior part of the anterior leg	29. ° C.	35.8° C.

is very young, it is dangerous to apply diathermy in such a manner. Due to the easy coagulability of the tissues the current will rapidly produce an extensive necrosis which one must know how to prevent. But this is no reason to proscribe diathermy for the young, as has actually been suggested. It suffices in order to guard against such an accident, to make use of a wet roller to apply labile diathermy, the current being closed by means of a foot switch. It is convenient in such cases to make use of Bordier's pliant dielectric on which the patient is placed while the operators move the roller firmly applied to the paralyzed extremity. The pliant dielectric replaces the indifferent electrode and removes every danger of a burn. The intensity of the current must be constantly controlled so that it does not exceed 300 to 400 milliamperes.

Diathermy must be administered daily or at least every other day until the temperature of the paralyzed extremity remains at fairly normal.

Independently of the employment of diathermy just described, the high frequency currents have been suggested for the purpose of stimulating resorption of the edematous infiltration at the level of the spinal cord. Mensi[5] has applied diathermy to one part or other of the spinal column in cases of very recent poliomyelitis. He has thought that by raising the temperature of the cord, the diathermy may attain the focus itself. This author reports several favorable results with this treatment which he obtained in the Kölliker Hospital in Turin.

3. *Galvanization.* The third agency in the treatment of infantile paralysis, is the galvanic current. The constant current is applied from the time the cold extremity has become warmed by a sufficient number of diathermic treatments. As this treatment must often be carried through many months, it is advisable to instruct the parents in the proper electric treatment of the muscular masses. For this purpose I have had constructed a small box containing all that is needed for galvanization — a battery of 40 volts and two sponge electrodes, one of 100 square centimeters, the other of 20 square centimeters. The latter serves to "wash" and press against the atrophied muscles, the battery yielding for this work 8 to 10 milliamperes. The battery has a long life and can be easily replaced anywhere. It has a great advantage over portable wet cells (bisulphate of mercury, and the like).

When the galvanic treatment can be given by an electrologist the rhythmic galvanic current applied to the mass of atrophied muscles will prove of remarkable efficacy, above all when the current reaches the patient after it has passed the rhythmic interrupter to the rotating inverter, which I have had constructed by the firm Lefine, of Lyon, some years ago.[6]

Results and Critical Considerations

The different publications I have presented about my method and the results obtained by it, have been received by some with indifference and skepticism. A certain number of physicians who were little enthusiastic *a priori* about the method, have asserted that the ameliorations or cures seen after treatment are the result of natural evolution of poliomyelitis in which one may observe even spontaneous amelioration. Such an argument is not to be taken seriously. Turano, who has treated a large number of cases of infantile paralysis by the new method states, "once the reaction of degeneration is established in a group of muscles one has never observed spontaneous return of active movements, return of reflexes, disappearance of the reaction of degeneration, nor return of excitability of muscles and of nerves."

It has also been advanced as a hypothesis that radiotherapy is not free from danger in young patients — but this objection is purely theoretic.

It is more than fourteen years that I have used this method and I have never seen a secondary lesion of the cord. The same conclusion has been reached by other authors, especially Bergamini in Italy. Experimentally

the labors of Labeau, in France, and of Deluca, in Italy, have shown that even excessively high doses of x-rays have no deleterious effect whatever on the spinal cord.

In a contribution published in 1930, Tixier[7] shows how little one is prepared to make use of the modern treatment of infantile paralysis by these words:

Two years ago I saw in the hospital a girl of two years who had suffered from the beginning of paralytic phenomena for about six weeks. I referred her to a pediatrician in the belief that she would be given the Bordier treatment during my vacation. On my return after a few weeks I saw that the little girl was completely paraplegic, limbs and hips limp and useless. I learned from the patient's mother that the child was returned home after a month's hospitalization without having received the least physical treatment, on the ground that the results of electroradiology were nil . . . . I could give a series of a dozen equally lamentable situations in which I have been called in the stage of poliomyelitis. In all these cases I have advised resort to the Bordier treatment and I have referred the patients to a specialist soon after the disappearance of the acute febrile stage. I have had the great satisfaction to see all my little patients get well, some entirely without a remnant, others with a minimal residue that did not impair their daily existence. One of the most striking effects was seen in a young man to whom I administered anti-poliomyelitic serum during the febrile stage without a tangible result. It was necessary to carry him for his first treatment with the x-rays. At that time he was incapable not only of walking but of standing upright. The radiologist left longer intervals between the séances on account of the difficulty of transporting the patient. After the second treatment he left the wagon unaided, and after the third séance he descended the three flights of stairs alone, supporting himself on the railing. Three months after the beginning of the disease he returned to his village walking normally and ascending stairs quickly. During the following year he was able to play tennis perfectly. It really was impossible to realize that this fine young man had been affected by a grave type of poliomyelitis! It is therefore an imperative duty for every physician early to refer his patients with infantile paralysis to specialists.

I add a few lines from the work of Professor Berghin of the University of Padua, who has used the new method in 65 cases of Heine-Médin disease:

It is simple to claim that the successes are the result of spontaneous regression and not at all due to treatment, denying the value of our therapeutic efforts. The answer to such critics is given by the records and the statistics, which include some complete cures with a return of the lost reflexes, with absence of atrophy and with complete disappearance of the usual trophic and circulatory lesions (in itself a marvelous fact!) and, finally, by the rapid amelioration by the Bordier method as compared with identical cases that were not so treated.

Portet[8] arrived at this conclusion: "After a long comparative study of the old treatment with the galvanic current and the present method of Bordier, the superiority of the latter is clearly demonstrated." Numerous authors have contributed their experience with the new method. I mention here Bergamini, of Modena, L. Turano, of Rome, Labordaric, Spéder, Sabattucci, Professor Serena, Carullo-Riera, Professor Chizzola of Udine.

Luges, of Lisbon, has applied the new method of diathermy, radiotherapy and galvanism in 44 patients with poliomyelitis and gives 47.8 per cent cures, 38.6 per cent improvements, and 13.6 per cent failures.

Durand-Daster, of Tarbes, had to care for a 13 year old child, a month after the appearance of the acute stage. He writes that the left leg was paralyzed and cold, and that a dozen diathermic treatments warmed the limb permanently and that six x-ray treatments enabled the child to walk unsupported.

In conclusion I report the results obtained by Manuel and Francisco Arce,[9] who during an epidemic in the region of Madrid, have treated all their cases by the combined method — diathermy radiothermy, galvanization. These authors made electro-diagnostic observations before and after treatment, and contrary to what has been accepted; namely, that there is an exaggerated electric excitability during the eight days following the febrile stage, they have found a decided diminution of electric reactions, even the day following the appearance of the paralytic phenomena.

I append the following tabulation of their first ten cases treated.

These authors after having treated 31 cases reached the following interesting conclusions:

We have observed that the most remarkable results are obtained in patients who have been subjected to treatment *immediately* after the appearance of paralysis. Good, but less complete results have been seen in cases treated two or three months after the febrile period. We do not desire to say that all patients who are immediately subjected to treatment must get well, for there are cases in which from the very beginning of the paralysis a profound destruction of the nerve cells permits of little amelioration. But if there are some cases in which the Bordier treatment is ineffective, there are on the other hand others with a reaction of total degeneration which have recovered after early and thorough therapy. If the results are not uniform in all cases, that is not the case in patients with a reaction of partial degeneration, for in the majority

TABLE 2. — *Poliomyelitis: Results of 10 Cases Treated by Bordier's Method (Arce)*

Case No.	*Age*	*Duration of Fever*	*Character of Paralysis*	*Start of Treatment After the Fever*	*Electric Reaction*	*Results*
1	2 yrs.	2 days	Flaccid, both limbs, walking and standing inability	30 days	Partial degen. region of poplit. sciat. external to the right and to the left	10 mos. later simple paresis of 2 limb. l. leg normal. Walking shows great amelioration
2	3 yrs. 3 mos.	3 days	Paralysis of right arm	28 days	Partial degen. of deltoid, biceps, brachial, pect. major, trapezius. On and under spines r. lat. dorsi	7 mos. later normal reactions normal movements. Cure
3	17 mos.	3 days	Paralysis of both thighs; walking impossible	20 days	Partial degen. both crural regions	5 mos. later. progress and walking show great amelioration
4	13 mos.	2 days	Paralysis left lower extremity; unable to walk	20 days	Total degen. quadriceps; part. degen. muscles of leg (left)	5 mos. later simple diminution of faradic excitation of quadriceps; normal reactions of limb; can walk. Very great amelioration
5	4 yrs.	2 days	Flaccid paralysis of l. leg and arm	1 mo.	Partial degen. of paralyzed muscles and nerves	3 mos. later normal electr. reactions. Cure
6	4 yrs.	3 days	Paralysis of r. leg; standing and walking impossible	20 days	Total degen. of muscles and nerves of thigh and of r. leg	3 mos. later, simple dimin. of electr. excitability. Can walk. Great amelioration
7	2 yrs.	3 days	Paralysis of l. shoulder, arm and forearm	28 days	Partial degree of paralyzed muscles	3 mos. later, normal reactions. Cure
8	5½ yrs.	2 days	Paralysis of both upper and lower limbs	15 days	Partial degen. more pronounced in legs	5 mos. later walking possible; normal movements of arms and hands. Great amelioration
9	3 yrs.	2 days	Paralysis of legs. Standing and walking impossible	3 mos.	Partial degen. marked in crural and ext. sciatic. poplit. regions especially on right side	2 mos. later treatment abandoned in spite of perceptible amelioration
10	14 mos.	2 days	Paralysis of r. leg; standing and walking impossible	8 days	Partial degen. of glutei. region of great sciatic and of ant. popl. sciatic	4 mos. later, normal reactions, standing and walking possible. Cure

— if not in all — excellent results have been obtained.

These conclusions, which are in accord with my own, appear to be stated judiciously, and for my part, I support them without restriction, for I consider them to be on the right path.

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THERMAL CHANGES PRODUCED IN TISSUES BY LOCAL APPLICATIONS OF RADIOTHERMY *

CAROL B. PRATT and CHARLES SHEARD

From the Division of Physics and Biophysical Research, the Mayo Clinic and the Mayo Foundation

ROCHESTER, MINN.

The short electric wave generator developed in the Research Laboratories of the General Electric Company was used in these investigations. In utilizing the energy of this high frequency field for the investigations of thermal changes produced by local applications of the field, small insulated condenser plates were attached by means of tubular telescopic rods to the large condenser plates.

Measurements of temperatures were made (series of 30 dogs) on the intra-articular and subcutaneous tissues of both knee joints of each animal after local application of the short wave field to the region of the knee joints. Condenser plates 2.5 by 3 inches, separated by distances which varied from 2.5 to 4 inches, produced the high frequency field into which was placed the part of the animal to be tested. The current density applied to the knee joints varied from 0.1 to 0.05 ampere per square inch of surface of the small auxiliary condenser plates. The frequency of oscillation of the electric field (which is not markedly affected by considerable variations in the distance and arrangements of the auxiliary plates) was 27.5 million cycles (wavelength of 10.9 meters).

In order to evaluate the errors in the measurement of temperature produced by the introduction of a thermocouple needle into tissue and the errors caused by the presence of such a needle in tissue during application of the short wave field, the following procedure was carried out. Thermocouple needles were introduced into the intra-articular and subcutaneous (at knee joint) tissues of one leg, and measurements of the temperatures were obtained over a 10-minute period. The leads were then detached from the needles, and the needles were left in position in the tissue while the short wave energy was passed through the knee joint. After cessation of the treatment, leads were again attached to the thermocouples and the measurements of the temperatures were taken over a 30-minute period. Immediately following this period, the short wave field was applied for the same length of time to the knee joint of the second leg of the animal. In this case the thermocouples were inserted immediately after the high frequency treatment had been completed, and the measurements of temperature were taken again over an interval of 30 minutes.

It was thus possible to ascertain the temperatures produced by application of the short wave field to tissue in which thermocouple needles were present during treatment. These temperatures theoretically should be somewhat higher than those of normal tissue in which no metallic needle is present. By delaying the insertion of the thermocouple needles into the second leg of the animal until after application of the high frequency field, it was possible to obtain readings of the temperatures produced by application of the short wave field to normal tissues, with, however, the recognition of the physical fact that these temperature readings were subject to losses due to the introduction of a low temperature needle of some thermal capacity and of considerable thermal conductivity. The temperatures thus obtained should be somewhat lower than the true temperatures of the tissues. By obtaining, on each animal, measurements of temperature by both of these methods (one some what higher than the true temperature and the other slightly lower than the true temperature) it is possible to estimate the effect of the high frequency field on the temperatures of tissues to a high degree of probable accuracy.

In 2 control dogs, examined in this manner and without subjection to the short wave field, significant changes in the intra-articular temperatures were not observed, but the subcutaneous temperatures rose slowly during the period that the thermocouple needle was inserted in the tissue. The average rectal temperature for the 30 dogs was 39.1° C. (102.3°

* Reprinted from the *Proceedings of the Society for Experimental Biology and Medicine*, 1935, **32**, 766-771.

* This paper is in the nature of a brief summary, more complete report to be published later.

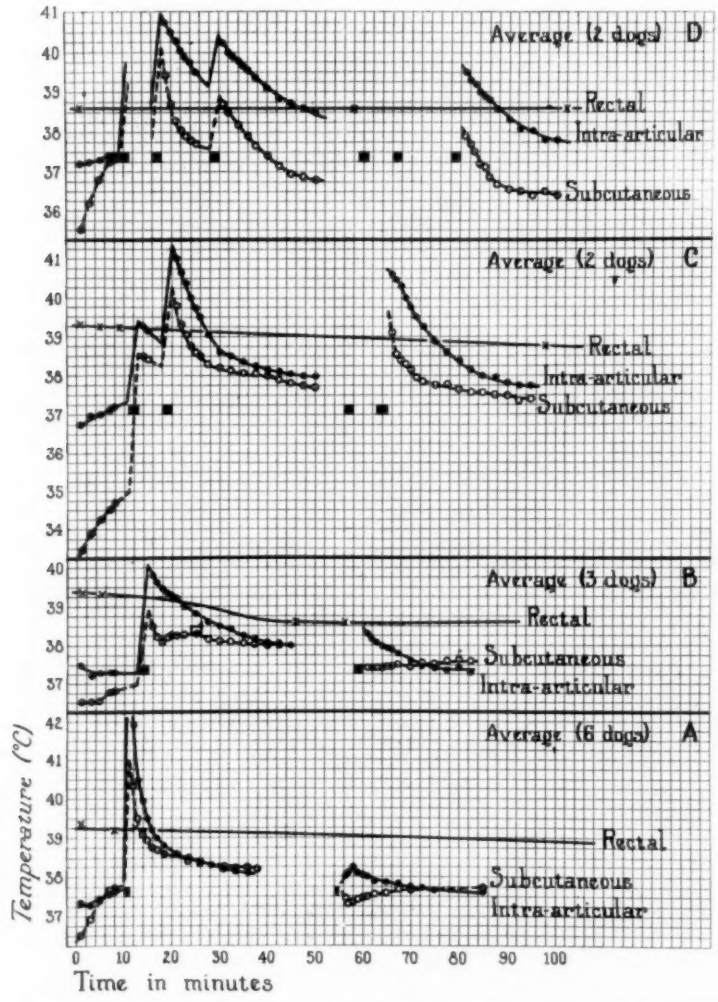

Fig. 1. — Curves showing the effects produced by the application of localized high frequency fields to the region of the knee joints of dogs. (Current density of 0.056 to 0.11 amperes per square inch, frequency of 27.3×106 cycles per second, treatment plates insulated and separated 3 inches.) The curves give the intra-articular, subcutaneous and rectal temperatures after the application of varying doses. In obtaining the curves of the left portion of the diagrams, thermocouple needles were inserted in one leg of the animal throughout the treatment; in the right portion, the thermocouples were inserted in the other leg of the same animal after the cessation of the field. Time of treatment and chronological order was indicated by the blackened rectangles.

F.). The average intra-articular temperature before application of the short wave field was 36.8° C. (98.2° F.). The average subcutaneous temperature in the region of the knee joints was 36.1° C. (96.9° F.). The rectal temperatures were not affected by local treatments of short duration.

Eleven dogs were subjected to the localized short wave field across the knee joint for 2 minutes, with a plate distance of 4 inches and a current density of 0.05 ampere per square inch. When thermocouples were present during treatment the intra-articular temperature rose 3.5° C. to a point slightly above the rectal temperature, whereas the subcutaneous temperature rose 2.5° C. but remained below the rectal temperature. *These temperatures dropped sharply after cessation of the treatment.* When thermocouples were inserted after application of the electric field, *the intra-articular temperature rose about* 1° *C.* and dropped very slowly with time, whereas the *subcutaneous temperature apparently was not at all affected by the treatment.* Two dogs were treated in this same field with an exposure of only one minute. The results for

measurements with thermocouples present during oscillation of the field were practically the same as those stated in the foregoing, but there was no change in temperature indicated by thermocouples inserted after treatment in both the intra-articular and subcutaneous measurements.

Two dogs were treated for one minute in a field with a plate distance of 2.5 inches and a current density of 0.09 ampere per square inch. The effects on the thermal changes of tissue as indicated by thermocouples, inserted during and after the oscillation of the field respectively, were identical. The intra-articular temperature rose 4.5° C. to a value well above the rectal temperature, and decreased approximately exponentially with the time after treatment. The subcutaneous temperature rose 5.5° C. to a value above both rectal and intra-articular temperatures.

The remaining 13 experimental dogs were treated under a constant distance of 3 inches between the plates of the auxiliary condenser and under a current density of 0.08 ampere per square inch.

Six dogs were treated for one minute through each knee joint. When thermocouples were present during application of the electric field, the intra-articular temperature rose 4° C. and the subcutaneous 3° C. Both temperatures were well above the rectal value and both fell very rapidly after cessation of treatment. When thermocouples were inserted after application of the field, the rise of intra-articular temperature was only 0.4° C. and the subcutaneous temperature was apparently not affected.

Three dogs were treated for 2-minute intervals in this same fashion. By the first method of measurement, the increase in intra-articular temperature was 2.5° C. and the increase in a subcutaneous temperature 1.5° C ; both temperatures fell slowly with the passage of time after treatment. By the second method of measurement, the intra-articular temperature rise was 1° C., but the subcutaneous temperature again appeared to remain constant.

Two dogs were treated in this same manner by 2 applications of the field, each for 2 minutes, with an interval of 5 minutes between applications. In these experiments the results of measurements with thermocouples present during oscillation of the field and of measurements with thermocouples inserted after application of the field were identical. The intra-articular temperature rose 4° C. and returned in an approximately exponential fashion to a constant value at the end of the 30 minutes of observation. The subcutaneous temperature rose 3° C. and paralleled the drop of the intra-articular temperature. Both temperature values exceeded the rectal temperature at their peak. Two dogs were treated in the same way, but an additional 2-minute exposure to the electric field was made 10 minutes after the second exposure. Again the temperatures obtained by both methods of measurement were practically identical and qualitatively similar to those described.

Summary. It is apparent that errors in the measurement of temperature, due to the presence of a metallic needle (thermocouple, without leads) in tissue during exposure of that tissue to a high frequency electric field are greater when the time of exposure is short and when the intesity of the electric field is low. The relationship of the heat produced in deep-lying tissues to the heat produced in superficial tissues is dependent on the distance at which the condenser plates are placed with respect to the locations of the tissues. This fact is of importance in the therapeutic uses of high frequency fields (radiotherms). When a considerable air space separates these plates from the surface of the tissue, the change in temperature produced in the deep-lying intra-articular tissue is greater than that produced in the subcutaneous tissue. The converse relationship maintains when the plates are placed close to the surface of the tissue. This dielectric layer effect is superimposed on any specific heating due to difference in constitution of tissue and variation in wavelength of radiation which may be present. Schliephake[1, 2] first demonstrated this type of depth effect of the high frequency field, and has presented experimental evidence which indicates that high frequency treatment plates which are allowed to make contact with the surface of tissue produce a tissue heating which is closely comparable with that of diathermy, in which the production of heat is predominantly in the superficial layers of tissue.

The experimental evidence presented clearly demonstrates that it is possible to produce

1 Schliephake, Erwin, *Klin. Wchnschr.*, 1928, **7**, 1600.
2 Schliephake, Erwin, *Strahlentherapie*, 1930, **38**, 655.

abnormally high temperature in a chosen region (*i. e.*, knee joint of a dog) by means of local applications of short wave electric energy of sufficient intensity. Furthermore, these relatively high temperatures may be produced in the deep (intra-articular) tissue of the region without the simultaneous production of high temperatures in the superficial (subcutaneous) tissues of the region (*i. e.*, portion of leg of dog) exposed to the high frequency electric field of the type used in these investigations.

PENETRATIVE AND SELECTIVE HEAT EFFECTS OF SHORT AND ULTRASHORT WAVES

(An Experimental Study With Unicellular Organisms and With Electrolytes)

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The following experimental studies were undertaken with a view of determining whether short and ultrashort waves have selective properties and thermic powers of penetration with bodies placed in a field of Hertzian short frequencies. These experiments, which were made both with electrolytic solutions and unicellular organisms elicited certain phenomena of an interesting character.

Before submitting the details of the experiments, it may not be amiss to point out that an ultrashort wave apparatus is essentially a wireless transmitting station. If, therefore, the lead-out wires should be connected with an aerial of suitable proportions, a 10-meter wave would be radiated into space. If, on the other hand, these wires are connected with two metal plates, placed close to the apparatus and opposite each other, we no longer have a 10-meter wave, but a so-called high frequency field. It can be readily appreciated that if these two metal plates are about one foot apart, it is physically impossible for the 10-meter wave to occur between them. We have, however, in this field electrostatic lines of force of the identical frequency of oscillations of a 10-meter wave — 30 millions per second.

Perhaps the most recent stimulus to investigation of the physiologic effects of short waves arose from the knowledge that men engaged in the vicinity of powerful sending apparatus experienced a rise of temperature, a fact which led to the introduction of fever therapy by short Hertzian frequencies. In contrast to the general heating of the body the local application of short and ultrashort waves does not appreciably increase the bodily temperature, but has effects which may be grouped as:

1. Production of heat in a limited region.
2. Undetermined effects on tissue cells, based on electronic action.
3. A direct effect on unicellular organisms, based upon the electronic action of extremely high frequencies.

We undertook first to establish whether there is a specific electronic action of short and ultrashort waves on unicellular organisms.

Kahler and Chalkley, in 1929, attempted to find out the effects of these frequencies on unicellular paramecium. They used a 3-meter and a 15-meter wave. Placing cultures of paramecia in a high frequency field they were able to destroy the organisms. It was found that the culture in the high frequency field heated up. As the temperature rose with the 30-meter wave, activity of the paramecia was affected and when the thermometer reached 41 degrees C. the paramecia were dead. The same effects were observed with the 3-meter wave. When cultures of paramecia were warmed, like results were noticed, with death occurring when the temperature rose to 41 degrees C. Their conclusions were that the results obtained depended purely on heat effects and not on any specific electrical action of the waves.

The wattage output of their apparatus was low, and for this reason the following experiments were made with short wave apparatus of 200 watt output for all wavelengths used.

The experiments were undertaken on cultures of paramecia with wavelengths of 6, 10, and 20 meters. Fifteen cc. of the culture in a glass tube was placed between two condenser plates, one inch away from the sides of the tube. Temperatures were taken with certified precision thermometers, after the cultures were stirred up, and while they were in the short wave frequency field. A drop of fluid from the culture was examined under the microscope, and the behavior of the paramecia noted. All cultures were under exactly the same conditions in the field, except that various wavelengths were used. They had an initial temperature of 31 degrees C. Examinations of all cultures were made at 33, 35, 37, 39, 40, 41, 42, 43, and some at 45 degrees C. In all the experiments care was taken that they were away from the center of the high frequency field.

Experiment 1. — Culture of paramecium caudatum at 20 meters.

At 33 degrees C. — Paramecia active and mobile.

At 35 degrees C. — Paramecia active and mobile.

At 37 degrees C. — Paramecia active and mobile.

At 39 degrees C. — Paramecia much less active, though some still move actively.

At 40 degrees C. — Paramecia, most have no motion, though some move sluggishly.

At 41 degrees C. — Paramecia, some still move very sluggishly.

At 42 degrees C. — Paramecia, no motion observed.

At 43 degrees C. — Paramecia, no motion observed.

Experiment 2. — Culture of paramecium caudatum at 10 meters:

Same results as experiment 1.

Experiment 3. — Culture of paracemium caudatum at 6 meters.

Same results as experiment 1.

Experiments 1, 2, and 3 were approximately of 60 minute duration.

The striking point brought out by the above experiments is, that irrespective of the wavelength used, the reaction of the paramecia was identical for all three waves and ran parallel to the temperature curves.

Experiment 4. — A 30 cc. culture of paramecia in a glass beaker was directly heated, and mechanically stirred to have an even temperature throughout. The results were identical with those of Experiment 1.

From the above findings the following deductions can be drawn: (a) a variance in wavelength does not produce microscopically any variations in the behavior of the paramecia; (b) direct heating produces upon the paramecia, at the same temperatures, the same effects observed in the high frequency field; (c) the causative factor in the short wave field is therefore the heat produced.

The above experiments, however, do not answer the following question: Is there any specific electrical action on the paramecia in a short wave field which does not depend on the production of heat? The following experiments were carried out for that purpose. Fifteen cc. of a paramecium culture in a glass tube was placed within a glass beaker. The beaker in turn was filled to the level of the culture in the tube with a culture solution of previous experiments in which the organisms had been killed. The paramecium culture in the glass tube was therefore entirely surrounded with fluid. This container was now placed in the high frequency field, with the plates opposite each other and one inch away from the sides of the beaker. Since dielectric constants of solutions influence their heating reactions, both the paramecium culture and the surrounding fluid would heat up at the same rate. It is of importance also to have both fluids of the same dielectric constant to prevent shielding effects.

The initial temperature of the culture and that of the fluid in the beaker was 31 degrees C. Temperatures of both fluids were taken very often and when the thermometer reached 33 degrees C., some of the contents in the beaker was drained off and chilled fluid added. In this way in all the succeeding experiments the temperature of the paramecium culture never rose above 33 degrees C.

Experiment 5. — Using a 6-meter wave, with constant temperature, after 1½ hours exposure, the paramecia microscopically showed no ill effects. This was repeated on three successive days, exposing the same culture for the same length of time. After 4½ hours exposure to a 6-meter wave the paramecia showed no change, nor did the protoplasmic appearance of the exposed and non-exposed paramecia show any difference.

Experiment 6. — A 10-meter wave with constant temperature was applied for a total of

6 hours; no effects on the paramecia were discernible.

Experiment 7. — A 20-meter wave was applied as in the preceding experiment over a period of 4½ hours; here also no effects were noticed.

Experiment 8. — While exposing the paramecia in experiment 7, 10 cc. of a culture was placed alongside the beaker directly in the high frequency field. This 10 cc. culture promptly began to heat up and showed exactly the same results as those in experiment 1.

From experiments 5, 6, 7 and 8 it can be safely stated that cultures of paramecia after prolonged exposure in a short and an ultrashort wave field, when controlled by chilling show no ill effects.

Since the chilomonas is a much smaller unicellular organism than the paramecium caudatum, experiments 2 and 7 were repeated with this organism. The results were identical with those of the paramecium.

From these experiments it is clear that ultrashort waves of 6 and 10 meters, and short waves of 20 meters have no specific electrical action upon unicellular organisms, and that death of these organisms is due solely to a heat effect.

Experiments In Selectivity

In order to ascertain the selective heat effects of short and ultrashort wave radiation, we undertook the following series of studies: Instead of utilizing unicellular organisms we resorted to electrolytic solutions in order to obtain a demonstration of their temperature changes in comparison with those of water.

Experiment 9. — Two 12-ounce glasses were placed within each other in a manner that the sides were 1/16th of an inch apart, the bottoms being separated by a cork. Two round 6-inch condenser plates were set ½ of an inch distant from the sides of the outer glass. An 8-meter wave with an output of 200 watts was used. A neon bulb held in the inner glass lighted up when the waves were generated, showing that they had penetrated the double glass walls. When the space between the two glasses was filled with tap water, the neon bulb did not light up, evidently because this form of energy did not penetrate that thin layer of water, which acted as a buffer to absorb the waves. This was confirmed by the fact that within 10 minutes the temperature of the water was increased by 5 degrees C. The question arises whether a limited amount of the waves did pass the water, even though it was insufficient to light up the neon bulb. To settle this problem a test tube containing a 3 per cent solution of permanganate of potassium was suspended within the inner glass below the level of the water. If any of the waves did penetrate the water, naturally the permanganate solution would become heated. A fifteen minute exposure produced no rise of the temperature of the solution.

We know, therefore, that a layer of water 1/16th of an inch in thickness can act as an effective shield against an 8-meter wave.

Experiment 10. — The above experiment was repeated with a 15-meter wave, with the identical effect.

Experiment 11. — Three glass dishes were placed within one another as shown in diagram 1. They were separated from each other by corks so that three spaces were formed. Space A contained 8½ ounces of tap water; space B, air; space C, 2 ounces of tap water. The level of the solution in space C was below that of the solution in space A. Width of space A, 6/8 inch; width of space B, 1/8 inch; width of space C, 1⅞ inch. The level of the water in space C was below that in space A. Temperature at start: Water in space A — 25 degrees C.; water in space C — 25 degrees C. After a 10-minute exposure the water in space A was 28.5 degrees C., while the water in space C measured 25 degrees C.

It is seen that the water in space A absorbed the waves as shown by its temperature rise. The waves did not penetrate to space C, because it showed no temperature rise. There are now two possibilities: 1. If space C had contained a solution of permanganate, the selective action of the wave might have caused it to penetrate through A, through the 1/8 inch air space between the two solutions and heat up the permanganate solution in space C. 2. The air space between the two solutions would be an effective barrier to the penetration of the waves to space C, no matter what electrolytic solution is used in comparison with the solution in space A. We assume that the solution in space A is an electrolyte, even of the weakness of tap water.

To settle these points we undertook the following test.

Experiment 12. — The experimental apparatus was left exactly as in the preceding ex-

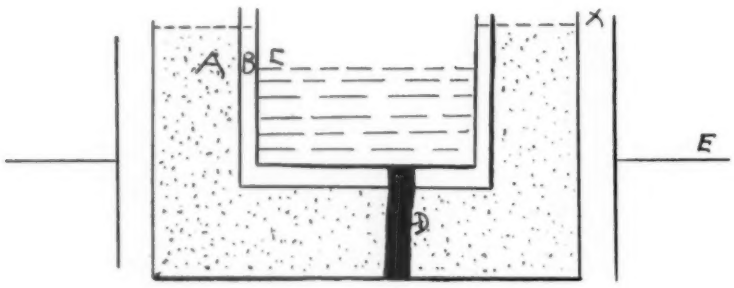

Diagram 1, A — Space A containing tap water; B — Space B containing either air or tap water; C — Space C containing 3 per cent permanganate solution; D — Cork separating the glass dishes from each other; E — Position of electrodes.

periment. The only change was the addition of potassium permanganate crystals to the two ounces of water in space C to make a 3 per cent solution. The outcome of this experiment (with an 8-meter wavelength at 200 watts) is presented in tabulated form (Table 1):

TABLE 1. — *Heating Effect on H_2O and $KMnO_4$*

Time (in Minutes)	Space A (H_2O)	Space C ($KMnO_4$)
0	24.5° C.	23.5° C.
5	26.0° C.	23.5° C.
10	28.0° C.	23.8° C.

This experiment shows that the 0.3 degrees C. temperature rise in the permanganate solution was due to radiation from the heated solution in space A, and that the 8-meter wave did not reach it. There are only two shields between it and the wave; namely, the air space immediately surrounding it and the tap water in space A. It must not be forgotten that the level of the solution in space C was at all times lower than that of the solution in space A. The question that now has to be answered is: If the air space were replaced by tap water in space B, would there be selective heat penetration? To solve this point we performed the following test.

Experiment 13. — Space B was filled with tap water (about ¾ ounce) above the level of the solution in space C. The experimental apparatus was otherwise not touched nor changed in adjustment. We now had 3 concentric layers of solution separated from one another by the walls of the glass dishes. The outside two layers contained tap water above the level of the permanganate solution in the inner layer. Table 2 shows the results of this experiment, also performed with an 8-meter wavelength at 200 watts.

TABLE 2. — *Selective Heating Effects on Electrolytes*

Time (in Minutes)	Space A (H_2O)	Space B (H_2O)	Space C ($KMnO_4$)
0	25.0° C.	25.0° C.	24.5° C.
2	25.3° C.	25.6° C.	27.2° C.
5	25.9° C.	26.5° C.	31.5° C.

We find that the permanganate solution now has heated up 7 degrees C. in 5 minutes, whereas the water in space A has only heated up 0.9 degrees C. The small amount of water in space B has heated up because of heat radiation from space C. By eliminating the air space we have achieved penetration through spaces A and B into space C.

We know therefore that an electrolytic solution has only one dilution for any one wave in which the maximum heating effects are noted. This means that there is only one dilution of any solution which will give perfect resonance with any one wave. Many authors have written on this subject. Granting this fact as a premise, our problem is the heating effects on various electrolytic solutions in a Hertzian short field, to determine actual penetrative ability of short and ultrashort waves.

In experiment 12, we find that the 8-meter wave oscillates at the rate of 37½ million times a second. When the wave penetrates the water in space A it produces the same frequency. These currents travel through the water in space A and come to the air space B which exists between the water in space A and the solution in space C. The current cannot jump the air gap B, because we are now not dealing with a wave but with an induced high frequency current. Therefore, the induced current in the water of space A cannot possibly effect the electrolytes in the solution of space C, because the air space B is not a carrier of induced currents. It was for this

reason that the permanganate solution in experiment 12 did not heat up.

In experiment 13 the induced ultra-high frequency current in the water of space A now had direct conductive contact with the water in space B, which in turn had conductive contact with the solution in space C. The air gap had been eliminated. Since the question of selective heating depends in part on the electrolytic content of the solutions, the permanganate solution showed a high temperature rise. The important point here is not the relative and absolute heating values of electrolytes in solution, but the fact that the 8-meter wave actually penetrated through the water in spaces A and B to heat up the solution in C. This I believe is conclusive proof of the penetrative ability of the ultrashort waves.

The possibility was considered that the 8-meter wave did not penetrate solutions A and B; that after having been deflected around the edges of the glass dishes it entered the solutions from the surface. If this deflection of the waves takes place, then the permanganate solution in experiment 12 should have become heated, which obviously was not the case.

To prove that the permanganate solution was heated up by direct penetration of the wave and not by deflected or bending electrostatic lines of force another experiment was initiated.

Experiment 14. — The apparatus was left exactly as in experiment 13 except that an iron cap was fitted over the surface of the glass dish holding the permanganate solution. If there were any possibility of the wave entering through the surface of the solution the metal cap precluded that eventuality. Table 3 shows the experimental findings.

TABLE 3. — *Heating With Control of Space C.* ($KMnO_4$)

Time (in Minutes)	Space A (H_2O)	Space B (H_2O)	Space C ($KMnO_4$)
0	21.0° C.	21.0° C.	21.0° C.
5	22.0° C.	22.7° C.	28.2° C.

We see that in spite of the solution in C being covered with a metal cap it showed a temperature rise of 7.2 degrees C., in 5 minutes, while the outside solution in space A only showed a temperature rise of 1 degree C. The 8-meter wave accordingly must have penetrated the outer two solutions to reach the inner one.

Absolute proof of selective penetration was obtained by the following experiment:

Experiment 15. —A glass jar 6¾ inches high and 6 inches in diameter was filled with tap water. Immersed in the center of the jar was a sealed one-ounce bottle containing a 3 per cent permanganate solution. The bottle was held in position by a fine thread one inch below the surface of the water. (Diagram 2.)

Two round 6-inch condenser plates were used and placed ½ inch from the sides of the jar. The temperature at the start was 26.0 degrees C. for both the water in the jar and the permanganate solution. After a 15-minute exposure to an 8-meter wave at 200 watts the temperature of the water in the jar at three different points rose to 28 degrees C. while the permanganate solution in the bottle registered 30.5 degrees C. The permanganate in the bottle had been heated 2.5 degrees C. higher than the water in the jar. Since the bottle was entirely surrounded by the water in the jar there must have been a selective penetrative action of the 8-meter wave.

From the results of the above experiments I believe the question of penetration of the 8-meter ultrashort wave to be definitely established. The above experiments were later done with a 15-meter wave at 200 watt output, using the same solutions. The same results of penetration were found, but the question of relative heating values is left for a future report.

In making certain variations of the above experiments a new factor bearing upon the heating of bodies in a high frequency field was discovered. At present the amount of heating of a body in a high frequency field depends upon the following factors:

1. Its conductivity.
2. Its dielectric constant.
3. Its magnetic permeability, if metal.

Since in the body there is no metal the question of magnetic permeability can be ignored.

Again, since in the body we are dealing with no homogeneous mass but with tissues of varying conductivity and varying dielectric constants, the question of heating (not considering fever therapy) is one of selective penetration plus the factor; namely, the cross sectional area of the body to be heated selectively lying parallel to the electrostatic lines of force in the high frequency field. The cross sectional area has no bearing upon the

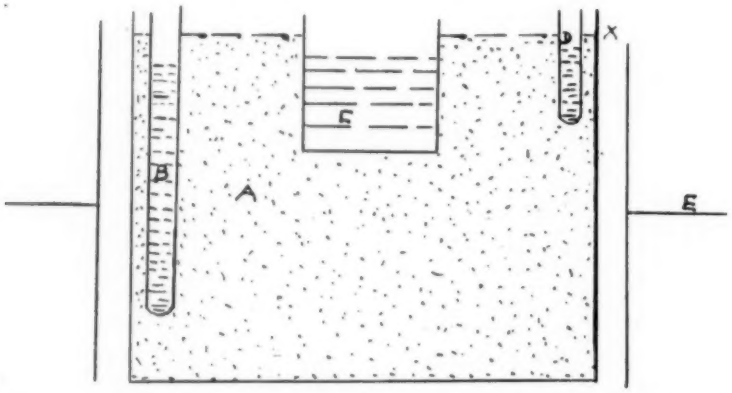

Diagram 2, A — Large glass jar containing tap water; B — Small test tube containing 3 per cent permanganate solution; C — Glass dish containing 3 per cent permanganate solution; D — Small test tube containing 3 per cent permanganate solution; E — Position of electrodes.

total volume of the body. This is illustrated by the following experiment:

Experiment 16. — A glass jar 4½ inches in diameter and 5¾ inches high was filled with tap water. Two condenser plates six inches in diameter were placed about ½ inch from the sides of the jar; the distance between the plates measuring 5½ inches. In diagram 2, A represents the tap water in the jar rising to level X shown by the broken line. C represents the 3 per cent permanganate solution in the glass dish, the level of which is below that at X. This glass dish was placed in the center of the large jar. Its diameter was 1⅞ inches and the permanganate rose 13/16 of an inch in height. It contained 1¾ ounces of solution. B is a ¾-inch diameter test tube, six inches long, containing 3 per cent permanganate solution. The height of the solution in the tube was 4½ inches and this was submerged in the jar below the level. The tube was ¼ inch away from the sides of the large glass jar. It contained one ounce of solution. D represents a 3 per cent permanganate solution in a 9/16 inch test tube, 2 inches high. This was filled with 1/5 ounce of solution and placed ¼ inch away from the side of the glass jar, and below the level X. The condenser plates were so adjusted that one was opposite each test tube, while the glass dish was in the center of the field.

The logical assumption would be that D being nearest the condenser plate would heat up the most, but it heated up the least. On the same basis C, being in the center of the condenser field and at the nodal point, would be expected to heat up the least. B having one-half the volume of C, and being placed very close to the condenser plate would also be expected to heat up more than C.

TABLE 4. — *Selective Penetration Through Parallel Electrostatic Lines of Force*

Time (in minutes)	Temperatures in A.	B.	C.	D.
0	22.5° C.	22.5° C.	22.5° C.	22.5° C.
5	23.5° C.	28.0° C.	30.0° C.	26.5° C.
10	25.5° C.	30.0° C.	33.0° C.	27.0° C.
	Repetition After 2 Hours			
0	23.0° C.	23.0° C.	23.0° C.	23.0° C.
5	24.0° C.	27.5° C.	29.5° C.	25.5° C.
10	26.0° C.	28.5° C.	31.5° C.	27.5° C.

The results show the opposite (Table 4). It is the cross sectional area of the three solutions that apparently had the greatest influence on the heating values. Thus C had a diameter of 1⅞ inches, and in spite of its nodal position showed the greatest heating effects. B had a diameter of ¾ inch, and in spite of its close position to the condenser plate heated up much less. Finally C with 9/16 inch diameter heated up the least in spite of its close position to the condenser plates and its small volume.

The importance of this is the consideration that must be given to the physical aspects of the various organs of the body when short or ultrashort wave therapy is to be given. This physical formation of the organs has hitherto received no consideration, but must be reckoned with in the future. From the theoretical applications it can be definitely said, that the smaller the cross sectional area of the body, the lower will be the wavelength in meters or the higher the frequency of oscillation necessary to give a maximum effect. Therefore,

only the very low ultrashort waves can have, if at all, a direct electronic action on bacteria.

The explanation of the above phenomenon is left for a later report, as experiments with other wavelengths are being done, and the altered conception of the high frequency field is under consideration.

We have made experiments to find out what the "field form" does to bodies placed in the condenser field. We know today that this field form induces currents when the human body is placed in it. It is the peculiarities of these induced electrical currents that now must be studied with particular reference to their phenomenon of selective heat penetration.

In order to determine the selective heating effects on living material we utilized chilomonas for experiments 17 and 18.

Experiment 17. — It was thought to be informative to conduct the experiments with the apparatus shown in diagram 1. Space C contained 3 per cent permanganate solution. Spaces A and B were filled with chilomonas culture.

Onset temperature of solutions was 25 degrees C. with an 8-meter wave at 200 watts. After one hour's exposure the temperature of the chilomonas solution had risen only a few degrees, much less than the lethal temperature for the chilomonas. During, and at the end of the exposure drops of the culture were examined under the microscope, and the chilomonas were found active and mobile.

Since the permanganate solution in the center heated up above 45 degrees C. — the high lethal temperature for chilomonas — the wave must have penetrated through the outside chilomonas solution. The chilomonas being in the path of the penetrating lines of force, the lack of any influence upon their behavior must be attributed to the absence of any specific electronic action.

Experiment 18. — Space C was filled with chilomonas culture, and spaces A and B with 3 per cent permanganate solution. Onset temperature was 25 degrees C. After one hour's exposure space C had only risen a few degrees in temperature and this chiefly from heat irradiation from spaces A and B. Space A had risen above 45 degrees C. — the high lethal point for chilomonas. Examination of the chilomonas after the exposure showed them to be active and mobile. It is evident that the permanganate solution in space A was acting as a shield to the penetration of the 8-meter wave. In this respect it must be pointed out that while this study utilized radiations provocative of lethal effects on unicellular organisms it must nevertheless be borne in mind that from a clinical standpoint the application of intensities to destroy bacteria *in vivo*, will also destroy cellular tissue at one and the same time. On the other hand intensities insufficient to destroy bacteria may be adequate for the production of favorable defensive reactions in the tissues.

Conclusions

1. Short and ultrashort waves have the power of selective heat penetration.

2. The cross sectional area of a substance plays an important rôle in its heating reaction, when placed in an induced field of high frequency currents.

3. Six, ten, and twenty meter wavelengths have no specific electrical action on unicellular organisms, death being due solely to heat effect.*

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SHORT WAVE THERAPY *

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Short wave therapy is in a limited sense a new subject, and is consequently one in regard to which our opinions must be in a state of flux, and however dogmatically we may assert them, they must be subject to correction and revision.

Short wave therapy covers a relatively brief space in the extensive range of electromagnetic vibrations. The diathermy wave length of about 300 meters corresponds approximately with that of the London Regional broadcasting center, and short wave therapy employs a wave length coextensive with that of the short wave wireless stations, 3 to 30 meters.

Throughout the whole range of known electromagnetic vibrations, extending from the longest Hertzian to the shortest cosmic waves, there is no breach of continuity; and so gradually does the distinction, which we draw between the action of adjoining wave lengths merge into its neighbors, that it is impossible to state where one begins and the adjoining ones leave off. Nowhere, in fact, can the truth of the old dictum, "Nihil per saltum Natura fecit," (Nature has created nothing by leaps) be better exemplified.

Impact Theory of Electromagnetic Vibrations

It would seem that the basic or fundamental action of all electromagnetic vibrations is that of a blow or impact. As Professor Sir James Jeans has recently stated in speaking of the frameworks along which our minds receive their whole knowledge of the outer world: "This knowledge comes to our minds in the form of messages passed on from our senses: these in turn have received them as impacts or transfers of electromagnetic momentum or energy."

In attempting to visualize the action of the electromagnetic vibrations, we are justified in retaining this dynamic idea of a blow or impact. It is true that one of the results of this impact is the conversion of the arrested kinetic energy into heat, so that diathermy when it was first introduced, caused us to attribute its action entirely to its thermal effects. Subsequently, however, it was found that effects ensued from the application of high frequency (H.F.) currents which could not be attributed solely to its heating action. D'Arsonval showed that the toxicity of a virulent diphtheria toxin could be destroyed by H.F. currents although the temperature of the medium did not exceed 98.5 degrees F. Other observers, working independently, came to the similar conclusion that the effects which they observed, such as the rapid disappearance of ecchymosis and swelling, could not be accounted for simply as the result of thermal action. Perhaps the most convincing experiments in this connection are those of d'Arsonval by which he established the fact that when administering these currents we are dealing with two entirely different types: (1) a current conduction, and (2) a current of capacity. This important point was revealed by the difference in heat generated when a H.F. current of constant intensity was passed through media of varying resistance. The remarkable fact was established that under these conditions H.F. currents did not obey the law of Joule. When an H.F. current of constant intensity was passed through salt solutions of varying resistance, the following degrees of heat were registered: With a resistance of 13 ohms, 2 degrees; when the resistance was increased to 1,500 ohms, the maximum heat of 86 degrees was obtained; but when the resistance was further increased to 35,000 ohms, the heat fell to the 2 degrees which was originally registered with a resistance of 13 ohms.

When employing media more complex than salt solutions, a lower degree of heat was obtained. D'Arsonval explained these phenomena by stating that "the sides of the containing vessel and the liquid interposed between the electrodes constitute not only a resistance, but also a condenser which heats up in accordance with the phenomena of hysteresis or of the dielectric viscosity at these frequencies."

These phenomena and conclusions are of fundamental importance in the study of short

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wave therapy, and their value is greatly enhanced by the fact that they art not *ad hoc* experiments, for they were published by d'Arsonval in 1927 considerably prior to the advent of short wave therapy.

The disruptive, pounding action must be more in evidence in these capacity currents than when the current flows freely through a good conducting medium; and the electromagnetic stresses must be greater in the former case.

A H.F. current will flow more readily by a path of good conduction than by a path of high dielectric hysteresis. This is well illustrated by the following unfortunate occurrence. An electrotherapist was treating a child's naevus by electrocoagulation. The child was placed on the condenser pad of Bordier, which consists of an underlying copper gauze electrode covered by an overlapping sheet of asbestos. The asbestos sheet, when dry, forms a very efficient dielectric of high viscosity. Unfortunately, during the operation the child passed water and so wetted the sheet at one point, thus affording a path of high conductivity to the H.F. current. At this point the current concentrated with the result that the child received a severe burn on his buttocks.

When H.F. currents of whatever wavelength are applied to the human body, they encounter the resistance of the skin. Through the skin, especially if it is dry and thick, owing to its high viscosity and hysteresis, the H.F. currents, as is the case with the glass containing walls in d'Arsonval's experiments, pass as capacity currents.

The further course of the current is influenced by the nature of the subcutaneous tissues or structures. If these tissues are, as is the case with muscles, well bathed in the highly conductive fluids of the body, the current will be one of conduction. If, on the other hand, there are subcutaneous bony structures or thick layers of fat, the current will be largely one of capacity according to their hysteresis or dielectric viscosity; or as Bordier well terms it, the current will pass as a leaking condenser effect. It is under the latter conditions that we shall obtain the maximum disruptive, dispersive, and pounding action of short wave H.F. currents. It is important to remember that, as the wave length becomes shorter and the frequency increases, the current of capacity more and more replaces the current of conduction, for the coefficient of viscosity increases as the square of the frequency. Consequently, the shorter the wavelength, the more important is the nature of the skin and subcutaneous structures. In the deeper tissues, owing to the high conductivity of the medium which surrounds and permeates them, the current will pass by conduction with wavelengths, at any rate, not shorter than 6 meters.

Currents of Capacity and Conduction

Now, in what respect does the biological action of these capacity currents differ from that of currents passing by conduction? We shall find the answer to this question best demonstrated by analogy with the experiments of Professors A. W. Wood and A. L. Loomis on "The Physical and Biological Effects of High Frequency Sound Waves of Great Intensity."

The apparatus employed in these experiments was a very powerful one, 50,000 volts and a frequency of 300,000 a second. The oscillations were obtained by means of a triode valve. One terminal of the apparatus was connected with a plate of lead, supporting several discs of quartz on which was placed a thin sheet of brass connected with the other terminal. The plates and quartz were immersed in a bath of transformer oil.

The following were among the results obtained: "Though the mercury only registered 25 degrees, the thermometer became so hot at the point at which it was held between the finger and thumb that it had to be released. The heat, of course, is developed by friction between the vibrating glass stem and the skin of the fingers, or rather by the rapid pounding of the transverse vibrations, and becomes unbearable only when the glass is squeezed tighly between the thumb and finger." Blood blisters persisting for several weeks were formed as the result of dipping a fine glass rod in the bath. Small fish and frogs were killed by submitting them for one or two minutes to the vibrations. "Filaments of living spirogyra were torn to pieces and the cells ruptured. Red blood corpuscles in physiological salt solution are rapidly destroyed, the turbid liquor becoming as clear as a solution of a red aniline dye."

Bordier obtained somewhat similar results by employing a 6 meter wavelength at a far lower voltage. Recently it has been reported that mice have been

rapidly killed in a powerful electromagnetic field of 1½ meters, and that flies, flying across such a field, dropped dead. The experiments of Wood and Loomis were not altogether confined to frequencies of 300,000, and it is of historical as well as scientific importance to note that workers record in the following passage the application of a 3 meter wavelength in experiments made seven or eight years ago: "In the case of a mouse killed by an exposure of two minutes between the plates of an air condenser operated at 1,000 volts with a frequency of 100 million, we found the temperature of the body cavity was over 113 degrees F."

It is evident that this dispersive and disruptive action will be largely governed by the part of the body to which the electrodes are applied. They will reach their maximum effect where there are bony surfaces or dense masses of fat. They will have least effect where the conductivity of the tissues is high, as in muscles and other tissues that are well supplied with blood and lymph. The lungs being in close connection with the bony thorax and containing innumerable air sacs, tend to the creation of capacity currents.

The better results claimed for the very powerful short wave instruments may be partly explained by the greater capacity effect obtained in the tissues as the wavelength decreases. The greater power of these instruments enables a shorter wavelength to be employed with sufficient energy. Though perhaps incapable of proof in the present state of our knowledge, it is reasonable to infer that the more delicate the structure, either of cells or micro-organisms, the greater would be the disruptive action of short and ultrashort electromagnetic vibrations.

Theory of Selectivity

It has been claimed that certain wavelengths have a specific and a selective action on certain micro-organisms and cells. It will be noticed that these wavelengths are in the neighborhood of the shortest wavelength which is obtainable with effective energy from the instruments at present available.

It is perhaps significant to note in relation to the so-called "specific, selective properties for certain cells" of waves up to 4 meters (Schliephake) that until a frequency of 10^7 (30 meters) is reached, the cell membrane is not penetrated by H.F. currents. It is, moreover, reasonable to infer that the permeability of all cell membranes will not be reached at the same frequency. This would not imply a specific or selective action, but rather a critical frequency beyond which the cell membrane would be more readily and completely permeated. If this is the case, the practical point arises that we should not endeavor to apply accurately a specific wavelength, but rather as short a wavelength as the available instrument will permit.

The claim that certain wavelengths have "specific selective properties for certain cells" savours far too much of the famous Schearer war hoax, in which it was claimed, as doubtless many will recollect, that each organ of the body had its specific wavelength, and that, if a wave of similar length was superimposed, sufficient energy would be developed to actuate a certain pricker, which when in action would perforate waxed paper, so that any organ of the body, or any abscess, or lesion of the organ could be delineated.

The claim for the improved or increased thermal action of these short waves, compared with the longer wave lengths of diathermy currents, will not bear investigation.

Despite the diagrams which illustrate the pages of short wave apparatus, the diathermy currents pass in relatively parallel lines through the tissues: whilst the current applied by the condenser electrodes of the short wave apparatus passes in one of two ways. If the electrodes are larger than the body to which they are applied, there is a certain concentration of the electromagnetic lines. But, if the electrodes are smaller than the body to which they are applied, which in therapy is practically always the case except in artificial fever induction, there is a considerable divergence of the electromagnetic lines. Consequently, the density of the current is less with the short wave than with diathermy. We can, moreover, get far more heat energy from a diathermy machine yielding waves of 300 meters, costing about $200.00 than from a short wave apparatus giving 6 meters and costing $1,000.00, or more, or probably than from a 3 meter costing $3,750.00. The reason for this is that a valve emitting 300 meter waves has an efficiency of 80 per cent; whereas, a valve emitting 3 meters has an efficiency of only 3 per cent. Consequently, if one only requires thermal effects, one will be well advised to

spend $200.00 instead of $1,000.00, or $3,750.00.

A very noticeable phenomenon of short wave therapy, and one which certainly tends to negative thermal effects, is the very slight or even total absence of appreciation of heat during the administration of a short wave treatment which may be followed by most satisfactory results.

Untoward Effects

So-called skin burns may unfortunately result from short wave therapy, in fact, I think, that far more care is required to avoid them than with diathermy. The absence or only slight sensation of heat which may attend their administration and the difficulty of measuring the current in the patient's circuit tend to their production. Distortion or concentration of the electromagnetic field may produce them. Subcutaneous masses of fat conduce to their occurrence. The main point of interest about these lesions, I hesitate to call them burns, is the manner in which they differ from the true heat burns of diathermy. They are far more painful than diathermy burns owing to the induration of the surrounding tissues which accompanies them.

I have only actually seen two of these lesions, but they are by no means uncommon, and in the administration of fever therapy they are said to be sometimes very severe. One of my cases was a hospital patient with a rheumatic knee thickly covered with fat. She was very carefully treated by the spark gap type of apparatus. After the treatment the skin was distinctly red, but there was no blister and no breach in the continuity of the skin. Subsequently, a small ulcer appeared about one-quarter of an inch square, this was surrounded by a swollen, thickened indurated area about 3 inches across with two or three indurated transverse ridges occurring by creases in the bandage. The condition was very painful, but the patient made no complaint, as her rheumatism had been quickly cured. On being asked why she did not complain of the heat during the treatment, she replied that she did not feel any heat, "only just natural like," to quote her own words.

The other lesion occurred whilst treating an elderly man for rheumatism of the shoulder by a 6 meter wave from a valve machine. The lesion was in this case a very slight one, so slight indeed as not to attract the patient's attention. But there appeared on his shoulder two deep red linear marks, which subsequently went through the color changes characteristic of a bruise. There was no ulcer, blister or breach of skin continuity. It appeared to be due to disruptive action rather than heat. Other observers have remarked that blood is extravasated from the veins after treatment by 10 meter wavelengths or less. Any erythema of the skin following diathermy quickly disappears: but the redness of the skin produced by short wave therapy may persist for some days. The former is a vasodilator effect due to heat, the latter is occasioned by extravasation produced by the pounding action of the capacity current in the skin.

I would summarize my successful results by stating that they have occurred under such conditions as would indicate a capacity current effect. In many cases this would merely be the result of a perturbation in the superficial tissues causing a dispersal of recent inflammatory exudation. In other cases a more powerful current actuating a shorter wavelength would result in a disruptive action on such conditions as superficial abscesses, boils, or carbuncles, and possibly on the specific micro-organisms themselves which have a causal relationship to these conditions.

I would, moreover, like to record the surprisingly quick or almost immediate results that are obtained by short wave therapy in certain cases. I have certainly not observed such immediate results from any other form of physical therapy, and I am of the opinion that most of these results can be explained by the dispersive action of capacity currents upon recent effusions. Perhaps, the most striking objective results are to be seen in the treatment of certain forms of varicose ulcers: the marked vascular engorgement and the subcutaneous induration, which ensues upon the treatment of these conditions, frequently necessitates intermission of the application. One is led to think that, if similar, or, as is often claimed, greater changes take place in the deeper tissues and organs, short wave therapy cannot be free from risk.

In conclusion I would like to express my firm belief that the advent of short wave therapy opens up a field of treatment of great possibilities hitherto totally unexplored.

PROGNOSIS IN CANCER

(With Especial Reference to Visible Neoplasms)

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The scientific management of any disease is based on exact diagnosis and effective treatment. In cancer, virulence and duration are vital factors. Early discovery and early eradication are essential. Of equal prognostic importance is appraisal of the type and grade of malignancy in each lesion, as a guide to our selection of the proper therapeutic agents. Operative surgery, electrosurgery, and radiation (radium or x-rays) have cured many thousands of cases. Nevertheless widespread pessimism persists in regard to the general outlook of the control of cancer. Its unknown etiology, the widespread ignorance of its early signs, and the ineffectiveness of any treatment for the all too frequent cases with extensive metastases are responsible factors. Malignant neoplasia occurs among all people and in all climes. It is a universally distributed disease among multicellular organisms throughout the globe. Mortality statistics reveal an ominous increase among all civilized peoples. Cancer now ranks as the second leading cause of death, one out of every ten persons dying from it.

A more optimistic viewpoint challenges the infallibility of mortality statistics as representative of either total incidence or curability of the disease. A larger percentage of our population is now surviving to the "cancer age" due undoubtedly to a greater proportion of cases being diagnosed at an early stage of the disease. A "Fight Cancer with Knowledge" campaign of education[1] has shown that a great majority of all cancerous lesions arise in the external envelope of the body, or in readily accessible cavities that are plainly visible to the well equipped medical examiner. Moreover, these lesions are for the most part either of low grade virulence, or sufficiently localized in their early stage to be cured with a minimum of inconvenience to the patient. Laymen in ever increasing numbers are reporting to their physician or to well organized tumor clinics for examination and prophylactic removal of ulcers, fissures, erosions, papillomas, and keratoses. The well informed layman of today knows the significance of a sore that refuses to heal, of a lump that grows, and the importance of discharges from any part of the body.

Many laymen now know that pain is not an early symptom of cancer, but follows infection, infiltration and ulceration in lesions no longer localized and curable. It is popular knowledge that the prophylactic removal of precancerous lesions, as well as the scientific management of malignant growths by surgery, electrosurgery, and radiation entails a minimum of discomfort. Modern medicine no longer defends a *laissez faire* attitude in the management of potential malignant lesions. Every case of suspected cancer is an emergency, and the attendant physician must assume the responsibility of providing an answer to the following questions: What is the pathological process? If neoplastic, is it benign or malignant? If malignant, what is its grade of virulence? Is the growth localized or extensive, fixed to underlying tissues, or metastatic in regional or distant lymph nodes? What is the general constitutional condition of the patient? Is a given malignant lesion operable or inoperable; radiosensitive or radioresistive; curable or incurable? If the lesion is inoperable by ordinary means, radio-resistive, and obviously incurable, can we still offer palliative relief by means of electrosurgery?

In the absence of any single infallible prognostic sign or laboratory test it is evident that in every case the prognosis must remain more or less empiric. "Experience is fallacious and judgment difficult" is an aphorism that applies to malignant disease. Nevertheless, it is also true that in perhaps no other disease entity does the prognosis of the ultimate outcome depend more upon the ability of the first medical consultant than in malignant neoplastic disease. This is true because in probably no other condition does the fate of the patient

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depend more upon prompt and complete extirpation, and upon the personal application by the physician of the curative agent in the form of kinetic energy — surgery, electrosurgery, or radiation.

David Starr Jordan once said, "The greatest wisdom is to know exactly what is the best thing to do next, and the greatest virtue is to waste no time in doing it." Ignorance, pessimism and fear have prevented the early prompt eradication of many precancerous or low grade malignant neoplasms. Knowledge, optimism and confidence are being substituted and external cancer now shows a declining death rate.

Prognostic Factors

Prognosis as to Organ Involved. Cancer of the skin is least fatal; buccal carcinoma slightly more so; followed by breast, female genitalia, rectum, peritoneum and intestine. Cancer of the stomach and liver have the highest death rate. Cutaneous cancer has shown a slight decline in death rate; it is more accessible for early diagnosis and eradication by physical agents. All other organs and regions show a rising cancer mortality curve[2].

Histogenesis and Prognosis. Microscopic examination (biopsy) is an invaluable aid in diagnosis, prognosis and control of treatment[3]. Gradation of malignancy according to its surgical pathology (Bloodgood) is as follows: Most malignant, chorioepithelioma, followed in order by small round celled sarcoma, melanocarcinoma, adenocarcinoma, fibrosarcoma, squamous epithelioma, basal-cell carcinoma and finally by epulis. Broders[4] classification of four grades of malignancy based upon the proportion of neoplastic cells which have departed from the normal, functional or differentiated type is useful but not infallible[5]. Microscopic sections from various portions of the same tumor not uncommonly show varying grades of malignancy. More elaborate histologic malignograms (Hueper[6]) are open to the same objection. In these studies, a mathematical evaluation of virulence is appraised from the cell type, its irregularity in cell and nuclear outline, the nucleoprotoplasm coefficient, chromatization, mitoses, and infiltration of the stroma. On the other hand, the following histologic data indicate resistance on the part of the host, and consequently a lower grade virulency and a better prognosis: functional activities in the growth, fibrous predominance in the stroma, with hyalinization and lymphocytic infiltration, as well as other evidences toward encapsulation of the growth. Marked vascularity of the stroma, the degree of sclerosis, and of de-differentiation are guides to treatment.

Histogenesis and Radiosensitivity. (Ewing[7]) Lymphoma is the most radiosensitive followed in order by embryonal tumors, anaplastic growths, basal carcinoma, adenocarcinoma, desmoplastic growths (squamous carcinoma and fibrocarcinoma) fibrosarcoma, osteosarcoma and neurosarcoma (glioma). Desjardins[8] has described a specific radiosensitivity inherent within both normal cells and in their neoplastic prototypes. Radiosensitivity varies inversely with the length of the life cycle; the short lived cells, e. g., lymphoid, leukocyte, endothelial and gonadal tissues are all highly radiosensitive; conversely the long lived cells such as fibrous and nervous tissues are markedly radioresistive. Epithelium occupies a position of varying radiosensitivity. Basal or germinative epithelium and glandular epithelium are supposed to be more radiosensitive than the upper layers of the skin. Squamous celled epithelioma, therefore is more often radioresistant than either basal-cell carcinoma or adenocarcinoma. Low grade epithelioma of either type not infrequently resistant to both x-rays and radium, yields readily to properly performed electrosurgery.

Clinical Factors Influencing Radiosensitivity[9]. Well vascularized lesions are highly radiosensitive, due to rapid necrobiosis of the vascular endothelium. Lesions which have invaded cartilage or bone, or in which gross infection is present are surgical in nature, and a cure should not be expected by radiation alone. Other less understood factors unfavorably influencing radiation are radiation fast lesions, constitutional types pigmenting poorly, as well as severely anemic and cachectic patients. Obviously, both microscopic and radiotherapeutic technic are an invaluable part of the modern armamentarium against cancer. On the other hand, they are far from infallible, but subject to technical errors well known to specialists proficient in their use. Teamwork with the pathologist, the radiologist and the operative surgeon, with careful clinical appraisal and surgical judgment are just as essential now as they were known to be before the factors of gradation

of cancer and its related radiosensitivity were recognized.

From the clinical viewpoint the following prognostic factors[10] may be listed in the order of their importance:

1. Presence or absence of gland involvement or distant metastases. (Very bad.)
2. Fixation of growth "frozen neck or pelvis." Adherence to bone, cartilage. (Bad.)
3. Location of growth in regions apt to develop inoperable extensions. (Also bad.)
4. Renal and cardiac complications. In the aged patient these may be more significant than the lesion *per se*.
5. Anemia, unless its cause is obviously unrelated to the neoplasm.
6. Size of the growth. This varies greatly with the type. Prognosis not so bad if the growth is fungous, papillomatous, or is a large superficial rodent ulcer, or other comparatively benign lesion. Size alone is not important.
7. Direction of the growth. If upwards and outwards, the lesion is less virulent than if infiltrative, ulcerative and indurated at its base. "Beware the cancer which is going away from you." (Mayo.)
8. Age of the patient. "The older the host, the less vicious the growth."
9. Loss of weight. "Cancertoxin" is a dubious term. Cachexia more commonly due to obstruction of the food tube, or to secondary infection, ulceration, or to insomnia due to pain. "Living cancer never kills." (Quigley.)
10. Cellular differentiation (Broders). Grade four lesions are fatal irrespective of age, size, duration of growth, and perhaps also of method of treatment. Grade one lesions may be cured by any agent adequate to destroy the local growth.
11. Other histologic factors, lymphocytosis, fibrosis, hyalinization and cell type.
12. Duration. Of little importance in low grade localized growths. Of much more importance in higher grade lesions, subjected to self neglect, inadequate medication, incomplete removal, incision, curettements or incorrectly used or futile radiation.

Within the past decade we have used electrosurgery in approximately 1,000 malignant neoplasms. More than one hundred of this series had proved radioresistant and an approximately equal number had recurred after some form of prior operative treatment.

Summary

1. A bad prognosis as to life is to be given in high grade, neglected lesions, or those with metastases and brawny induration due to extension and fixation of the growth, which has followed medical procrastination, or maltreatment by caustic pastes.

2. An uncertain prognosis as to life, but a definitely bad prognosis as to mutilation pertains to lower grade lesions, which had resisted prior radiation, or any operative treatment which had not completely extirpated the growth. Widespread resection or amputation that is required for the necessary excision through normal tissues beyond the limits of the growth, or the radiation cicatrix, necessarily leads to mutilation. Bone resections, sequestrectomies, control biopsies, plastic operation are often necessary in these otherwise incurable cancer derelicts.

3. Low grade localized lesions have an excellent prognosis, if excised by electrosurgery.

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Discussions *

(Papers by Drs. Lederer, Kolischer, Stevens, MacKee and Cipollaro, and Kime.)

Dr. William L. Clark (Philadelphia): There is considerable doubt in many minds as to a difference between electrodesiccation and electrocoagulation. There is a difference. They both have their uses, the desiccation method being indicated where we desire to obtain a good cosmetic effect. I think it is our duty, for humanitarian reasons, to get good cosmetic effects.

By desiccation we obtain a type of necrosis with long-drawn-out nuclei, without the cells, however, losing their identity. We have found by experience that the cosmetic effects are better.

It has been frequently remarked that we must not use electrosurgical methods for lesions above the eye, that we must use radium. That is fine so far as it goes, but I prefer always to use desiccation of the lids and canthi. Up to date I have treated over 500 cases of epithelioma of the lids and canthi alone, and I have no reason to regret the results. The penetration of the high frequency current destroys the cells beyond the point of primary destruction with a consequent disappearance of the malignant cells and conservation of what appears to be the normal cells. In practice, I think we should go well beyond that. However, to demonstrate what can happen, I present a case of a sarcoma where only part of the growth was destroyed. There was entire disappearance with fair conservation (slides).

Nearly 25 years ago the question came up as to whether or not tattoo marks, or similar marks of identification, could be obliterated from the arms or face, or some other place on criminals. In one man who submitted to an experiment I removed an area the size of a 25-cent piece. There was no keloid. It was perfectly smooth except for slight bleaching. It has often been said that there was no method for removing tattoo marks, but the desiccation method is very satisfactory. It is a technic I recommend. I have had many such cases and the results have been gratifying.

Anyone who treats cancer should be prepared to treat patients by any means that have proved of value. One who depends upon surgery will have a limited range of success. The man who understands all other available measures and is in a position to employ each alone or in combination, will have a wider field and superior results.

Electrosurgery has a field of application in breast cases. To insure therapeutic results cases must be carefully selected, since stereotyped application of electrosurgical procedures for any and all cases is likely to fall short of our aims.

Dr. Gustavus M. Blech (Chicago): Dr. Lederer represents a specialty which is not my field. Problems of a technical nature are involved in his work which the general surgeon is unable to attain to the degree of perfection he has. I will remind you only that it is one thing to amputate a mammary gland and another to extirpate a larynx and substitute a speaking organ in a sense of reconstruction. That exemplifies the difference in the technics of laryngologic and general surgery.

If Dr. Kolischer has done nothing more today than to bring us a message that there is more to carcinoma than a tumor with cells running wild, and that there are constitutional factors which must be considered, so that our treatment should not be limited merely to surgery, irradiation and electrosurgery, he was well worth hearing.

Regarding the paper by Dr. MacKee and Dr. Cipollaro, I agree in all except one particular, and that is that there is no reason why in cutaneous carcinomas there should be any objection to removing the tumor completely. I do not care whether a malignant neoplasm is diagnosed only tentatively, one might as well take out the whole tumor. Such a procedure assures a correct biopsy.

In the last few years I have had five cases of sigmoid carcinoma, four of them diagnosed at a fairly early stage, and one, a woman, where diagnosis was made after the appearance of obstruction. In two of the men, both in their forties, a four-stage operation was done. They made recoveries. Both of them are in public service. One woman was operated on and is doing well. All of those were done by the same method. In one woman I didn't get to the third stage, because she died about three weeks after her attack of obstruction. In spite of all efforts she grew weaker and weaker and passed away.

You have here an example of how imperfect a prognosis one can make on histologic classification. Dr. Kolischer is right, all of our groupings, according to cell histology, will not help us much. We have constitutional factors, perhaps hormones that are effective. The answer also is that we have a lot to learn about carcinoma as yet.

Dr. J. Thompson Stevens (Montclair, N. J.: Dr. Clark gave a most interesting discussion and showed some cases of excellent results. There are some beautiful results that we can obtain by the same method of treatment in cancer of the bladder, cervix, and other organs. The wounds heal nicely on the surface of the body, and they will heal equally well in depth, providing one reaches the diseased site. There is less accompanying deformity and malfunction of the organs following electrosurgical operation.

Dr. Grant E. Ward (Baltimore, Md.): The principle of employing various methods for the treatment of cancer is comparable to that of employing various drugs in the treatment of certain diseases, particularly those which are not completely understood either as to etiology or as to proper therapy. I see no argument against the employment of any one of several modalities in the treatment of cancer. There is no one method that is 100 per cent sure or else cancer would not be in second place on the list of those

* The reader is referred to the published articles on the Cancer Problem which have recently appeared in this Journal.

dead in this country per year, or even throughout the world.

The susceptibility of tumors to irradiation is a weighty question, but we cannot always predict the end-result of the tumor by histological pictures. That simply leads to the question of a fundamental and inherent tendency in the individual to develop cancer. One of the most important arguments in favor of such a theory is the fact that many thousands of people receive the same injuries in the same places and yet only a certain percentage develop cancer. There is something inherent in their constitution that develops this disease. What it is we do not know.

I think the age factor an exceedingly important consideration in some problems to solve or to study in regard to the treatment of cancer or the cause of cancer. It is quite well known that most people who develop cancer in the first thirty or forty years of life have a much more serious prognosis than those who develop it in the later years.

Before I left Baltimore a few days ago, I operated on an 81-year-old lady. She was obstructed by an undiagnosed and symptomless cancer. She was an inmate in one of the institutions and had no symptoms until the obstruction occurred. People marveled that she stood the operation. Yet, she never would have reached 81 years if she had not had the resistance to live to that age.

There is a resistance to the growth of any tumor in an old person. If we could find out how we could make people old, so to speak, and retard the growth of those cells by some biological substance, or reaction, we would make another step in the development of our cancer therapy.

I wish Dr. Kolischer would tell us just a little bit more of his technic of obtaining these cells. It is something that is affecting the growth. I would like to know a little more about that.

Dr. Francis L. Lederer (closing): There is naturally a great disadvantage in developing therapeutic agents long before everything is known about them and about the disease itself. You have to free yourself from some of the prognostic teachings, the hopeless prognostic teachings of former years. If I did not know Dr. Kolischer well enough, I would go away from the meeting feeling that the entire cancer situation was too hopeless even to try to carry on.

There is another danger. At a recent meeting in Chicago, there was a sort of "pep" session. It was called for the purpose of conveying to the layman the results that had been achieved in combating cancer. The danger there is that it inculcates in the layman a certain feeling that cancer is a disease that is absolutely curable. It gives the physician a feeling not of hopelessness but of finality in progress, which is highly undesirable if progress is to be made.

I tried to show in my part of the discussion that there were many angles to be considered; that there was not only one treatment but many. This is not a matter of pitting one method against another. There are times when we think of cancer as a disease of infectious origin. Vaccines, the various bacterial therapies, and all the other therapeutic agents bring back to mind the possibility that Dr. Kolischer is working where others labored decades ago so that one wonders whether there is anything new under the sun in therapy.

The fault that he found with us as clinicians was that we are empirical. We admit we are, because we do not know the origin of this disease. There is a definite empiricism in his recommendation, too. I do not feel that we should dismiss bacterial agents or vaccines; we should be open-minded about them but cautious at the same time.

I had no idea of conveying to you that there was a stereotyped manner of either treating malignant neoplasms or judging malignancy. That would be very disappointing to anyone dealing with this disease. I am sure that clinicians have no such idea. There is a didactic means of demonstration that has no place in scientific problems.

Dr. Gustav Kolischer (closing): Evidently I have been misunderstood by some of the gentlemen. It is very far from my mind to belittle the efforts of men who are active in the surgery of the scalpel or in radiotherapy. I wanted only to point out the limitations of the present methods.

As to the etiology of cancer, the probability is that there is not one but a multiplicity of causes. Consequently, we aim our therapeutic effort for these multiple causes, not the direct causes of cancer but all factors they may influence in the final results.

I want to call your attention to Ward's work. He is one of the men who most elaborately developed preparatory methods in order to insure a better success for electrosurgery. And he succeeded in that. The same holds true for all methods of cancer therapy. We admit that our methods do not furnish results in a majority of cases. We know that in certain diseases the only progress and treatment that was made was by applying theoretical knowledge to a practical work. I simply want to apply the results and the knowledge that was developed by biologists to our treatment for cancer. I want simply to start the ball rolling for a biologic treatment of cancer. It doesn't do any good to repeat ourselves and repeat certain things as positive to the professional public, because we haven't "arrived" yet. But it is logical to base practical therapy on biological principles and theoretical knowledge.

Dr. Anthony C. Cipollaro (closing): Regarding Dr. Blech's question, when we take a biopsy of a small lesion, we destroy that lesion completely by whatever method we use to take the biopsy, whether it be by scalpel or by electrosurgery. Usually, however, we take the biopsy from a rather large lesion and for cosmetic reasons we wish to destroy no more than we can absolutely help.

After having learned the nature of the tumor that we are dealing with, we can select the method for its destruction. If it is of a benign nature

we wish not to destroy too much of the tissue for cosmetic reasons.

There are lesions, for example, that are suspicious of malignancy, or there are lesions developing in other conditions, for instance, in scars from burns, either that or from syphilis. Also, there is epithelioma which has a large lesion. We wish to learn the nature of those suspicious spots. We only remove a portion of that for microscopic examination. If the lesion is small, I repeat that we destroy it entirely when we do the biopsy. If the lesion that is suspicious is in a large area of some other type of pathologic growth, we remove only a portion of it.

ROENTGEN AND RADIUM THERAPY IN THYROTOXICOSIS *

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Menville,[1] at the Seventeenth Annual Meeting of the Radiological Society in 1931, presented data collected from 38 states and 75 radiologists on the results of irradiation in the treatment of 10,541 cases of thyrotoxicosis. The general average of cured cases was 66.22 per cent; of relieved or improved but not cured was 21.07 per cent. While these figures are at least equal to those obtained by any other method of treatment, it is felt that they do not show the real value of irradiation in thyrotoxicosis. This contention would seem to be supported by the fact that 15 or 20 per cent of the radiologists reported results exceeding 80 per cent of cured cases.

Jenkinson[2] says: "About 80 per cent of exophthalmic goiter will respond to x-ray therapy and in the failures, which number about 20 per cent, it is our experience that very little benefit is received, regardless of what type of therapy is used." Holzknecht,[3] in 1928, stated that from 80 to 90 per cent of his cases were either cured or markedly improved. Pfahler,[4] in an analysis of 698 cases of goiter, treated 440 of hyperthyroidism of which 87.9 per cent were cured or markedly improved by irradiation. In 305 cases of thyrotoxicosis, Groover, Christie, Merritt, Coe, and McPeak,[5] reported 271 or 88.85 per cent, cured; 26 or 8.52 per cent improved. The figures for the cured and improved cases total 97.37 per cent.

Author's Statistics

The study and treatment of thyrotoxicosis by irradiation has been of vital interest to me for many years. In 1921 my first paper appeared in *The New York Medical Journal*,[7] five years later a second paper was presented before the Radiological Society of North America and was published in *Radiology*[8] in 1926, and a third paper upon this subject read before The American Roentgen Ray Society in Montreal, Canada, was published in *The American Journal of Roentgenology and Radium Therapy*[9] in 1928. At the Philadelphia meeting of the American Medical Association in 1931, it was my privilege to discuss again the treatment of thyrotoxicosis by irradiation and to record my results in 270 controlled and carefully followed cases. This paper was published in *The Journal of the American Medical Association*,[10] December 5, 1931.

This report is based upon the experience with 360 cases of thyrotoxicosis treated by irradiation. Of these 324, or 90 per cent, experienced perfect health following the treatment and were therefore classed as cured, another 4 per cent showed definite improvement but were not cured, since these patients still suffered with myocarditis and other heart ailments. Recurrences of thyrotoxicosis were surprisingly few in this series of cases and were noted in only 3 per cent of instances. In 6 per cent of the cases, in spite of the fact that the patients cooperated and the details of the treatment were correctly executed, failure or little or no benefit followed. Forty-five cases in this group were irradiated post-

* Read at the Thirteenth Annual Meeting of the American Congress of Physical Therapy, Philadelphia, September 10, 1934.

operatively because of surgical failure. No case classed as cured or improved was so called unless at least one year had passed since the date of the last treatment. By a cure is meant that the pulse returned to normal; lost weight was regained, patients frequently being a few pounds heavier following treatment than their best weight before the onset of the disease; tremor disappeared; the thyroid tumor disappeared, and the basal metabolic rate returned to normal.

Types of Thyroid Disease Selected for Irradiation

If the best results are to be secured in the treatment of any disease by any method, one must make sure that the diagnosis is correct and that the treatment given has curative or palliative value in that particular malady. If a high percentage of favorable results is to follow irradiation for thyroid disease, one must make sure that the cases one irradiates are of the toxic type, that no non-toxic types of goiter, with the exception of carcinoma of the thyroid, are subjected to irradiation. Non-toxic goiters are in my opinion always a surgical problem simply because irradiation will not remove them. Therefore, given carefully selected cases and a *correct radiotherapeutic technic*, irradiation is indicated in just three types of thyroid disease that are within the limits of the discussion of this paper. The first type one may except a cure to follow irradiation in a high percentage of instances is known as (1) *toxic goiter*, which is due to an increase in the numbers of perhaps normally secreting cells (hyperplasia) of the thyroid gland. In cases characterized by hyperplasia there is a tumor at the site of the thyroid gland. The tumor may be visible upon direct inspection, or it may grow downward into the mediastinum, where it can be demonstrated by a roentgen examination. For such a condition associated with the symptoms and physical findings of thyroid intoxication if correctly managed and treated by irradiation, only rarely will anything else be necessary. In the disease known as (2) *hyperthyroidism* one finds special indication for irradiation. Here the thyroid cells are probably normal in numbers, for no thyroid tumor is visible upon direct inspection, nor can one be demonstrated by a roentgen ray examination of the mediastinum. In such an instance the history and the physical findings point to thyroid toxic disease. The third type of thyroid disease in which irradiation is indicated, and in this disease the treatment should be carried out by radium implanted into the nodules rather than by roentgen therapy, is known as (3) *toxic adenoma*, which is characterized by thyroid intoxication with one or more nodules or hard masses in the lobes of the thyroid gland or isthmus.

Irradiation of Toxic Adenomata

The results of irradiation of toxic adenomata have been so uniformly good when treated by radium element needle implantation, that no other method of irradiation has been used since 1920. In a few cases roentgen irradiation has been used preliminary to radium therapy in extremely toxic cases. This treatment, when combined with quinine hydrobromide taken by mouth and rest in bed, has lessened the toxicity sufficiently to make it possible to safely insert the radium needles into the mass or masses within the thyroid gland. During this preliminary roentgen ray treatment, little or no valuable time is lost, since one can meanwhile get acquainted with his patient and gain his confidence, thereby taking a step in eliminating shock which patients with thyrotoxicosis withstand so poorly.

No doubt there are some who may be startled by the above statments, because it has been stated that toxic adenomata should be removed surgically for fear that malignant degeneration may take place at some future time. In 1932 Pfahler collected data from nine radiologists in this particular field, myself included. Together we reported 1,200 cases of toxic adenomata and, as Pfahler says, "none of us has seen a case in which there was found malignant degeneration after irradiation."

Management of Recurrences

As has already been stated, cases of thyrotoxicosis that have been correctly treated by irradiation suffer from surprisingly few recurrences. Certainly they are no more frequent than when the disease has been treated by other present day methods. In this series of cases only three per cent suffered recurrences, and all of these save one, occurred in patients who had less than the usual amount of treatment. Generally most cases of thyrotoxicosis require from six to ten series of roentgen ray treatments to eradicate the disease. In these recurrent cases the disease had apparently been brought to a satisfactory end-

ing by two to four series of treatments and during the year of follow-up toxic symptoms reappeared. Upon resuming their treatment by irradiation, it was found that the glands were still sensitive to the rays and that it was only necessary to add enough treatment to bring the dosage in each case up to about the general average of primary cases who had suffered no recurrences. Therefore, it is felt that when a patient who has been successfully treated by irradiation for thyrotoxicosis develops a recurrence, further irradiation may be expected to produce a permanent result.

Clinical Course Following Irradiation

1. Occasionally patients with toxic goiter and hyperthyroidism suffer from increased toxicity for a few days following the early treatments. Fortunately this very rarely occurs and is soon followed by relief, and gradual improvement takes place.

2. Nausea, vomiting, and diarrhea, when present, are among the first symptoms to improve or disappear.

3. Early during the course of active treatment the strength begins to improve and pruritus disappears. Soon the weight increases, while palpitation, tachycardia, tremor, dyspnea, and the tumor decrease and finally disappear. At this time the basal metabolic rate will generally be found to be within normal limits.

4. The eye symptoms are among the last to disappear, and in some cases the exophthalmos never completely disappears. This is also true in cases treated surgically.

5. In patients who have had severe thyroid intoxication for months or years, myocarditis frequently develops. In these cases the pulse rate is lowered but may never return to normal, no matter what the method of treatment, whether radiologic or surgical.

6. If toxic goiter is superimposed on simple goiter, cystic goiter, and other forms, the original tumor remains after treatment, and the enlargement of the gland appearing at the time of the development of toxicity disappears. In hyperthyrodism, i. e., thyroid intoxication without enlargement of the thyroid gland, superimposed on simple goiter, cystic goiter, and other forms, treatment is not followed by any reduction in the size of the primary tumor.

In conclusion it is felt that those who have had considerable experience in the treatment of the symptom complex known as toxic goiter, hyperthyroidism, exophthalmic goiter, Grave's disease, Basedow's disease, and so on, by roentgen rays and radium, will agree that there is probably no treatment for any disease followed by better results than that of correct irradiation in cases of thyrotoxicosis. It is so easy, by frequent clinical examinations and basal metabolic estimations done between the periods of irradiation, to obtain beautifully perfect results in from 85 to 95 per cent of instances. In fact, it might be said that the results of irradiation in thyrotoxicosis closely approximate the excellent results of the experienced surgeon in cases of appendicitis. As you know, under other methods of treatment of thyrotoxicosis generally only an improvement in clinical conditions follows, at least there are very few perfect results.

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Discussion

Dr. Israel Bram (Philadelphia): Dr. Stevens' results are those of an expert roentgenologist. Taken by and large, radiation alone in exophthalmic goiter is subject to not quite the objections that apply to surgery. In this type of patient surgery, though psychologically persuasive, is clinically irrational.

The importance of this subject cannot be overestimated, for the prevalence of exophthalmic goiter is increasing with alarming rapidity throughout the civilized world.

We are living in an emotional world in which many of us are paying excessively for existence in terms of misery through maladjustment. The malady we call exophthalmic goiter or Grave's disease is the price paid by humanity for the blessings of the type of social evolution we choose to term civilization. Nature will not be abused without retaliating.

The candidate for exophthalmic goiter is by heritage an idealist relatively incapable of fighting his way through the vicissitudes of life without scars. It is the nervous system and ductless gland mechanism — of major importance in exophthalmic goiter — that are most sensitive to disturbing events. These persons are high strung, emotional and thin-skinned — an interesting and ambitious lot — giving to the world many artists, writers, musicians, painters, educators, captains of industry, and leaders of men. Susceptibility alone is an unconscious quality, largely objective, typifying but not incapacitating the individual. The expert can recognize the earmarks of susceptibility and suggest measures for the protection of the individual's future.

It is therefore apparent that the psychic factor permeates this problem. In 25 years of intensive work in this field, I find that almost invariably there is elicited as cause a history of nervous shock or psychic trauma based on the fear instinct. The heart hurry, emotionalism, swollen neck, bulging eyes, trembling, and emaciation characterizing the malady occurred shortly after the incidence of excessive worry, death of a loved one, an accident, or other event in which the nervous system received a staggering impact. During the World War thousands of our boys were sent back from the firing line with exophthalmic goiter. In recent years, many developed the disease through the shock and worriment of the financial depression with its Wall Street crash, bank failures, foreclosures, and distressing changes in living standards.

Since exophthalmic goiter is a constitutional affection, there is no short cut in the treatment of this disease. Taking for granted a mere attack on the thyroid gland as the specific cure is a mistake. There is a common denominator in the treatment of exophthalmic goiter that is vital. I refer to the management of the patient behind the disease, without which no mode of treatment can succeed. In selected cases expertly applied radiation to the thyroid constitutes but a supplement within a broad regime of attention. To be effective, treatment must be applied to the individual as a whole and include a consideration of diet, medicaments, sleep, work, play, social, sexual and mental habits, and even an alteration of the individual's definition of happiness.

Psychotherapy is a basic necessity in efforts to rationalize and train the patient to face the struggle for existence with the confidence and imperturbability so essential to self-preservation. In his efforts at mental adjustment the knowing physician is the architect who aims at correction of discoverable weak links and vicious circles characterizing his patient's physical and mental existence. It is through such an all inclusive program of treatment that the patient is restored to health and happiness.

Dr. E. W. Carr (Lyons, New York): Several years ago, two German writers (whose names I cannot recall at this time) wrote quite extensively of the use of beef's blood in the treatment of exophthalmic goiter that failed to respond to x-ray. I have used the same treatment in four cases, but my list of cases is too small to put any real credence in them.

I would like to ask Dr. Stevens, or anyone else present, if they have had any experience with that form of treatment and what were the results?

Dr. C. F. Voyles (Indianapolis, Indiana): Did this series of cases reported by the essayist get iodine at the time when it was possible to give it, and did that influence the results?

Dr. J. Thompson Stevens (closing): Of course, we use other methods of treatment in addition to the irradiation. In the cases that are severely toxic, we often observe a basal metabolic rate above 50 per cent. Patients who are in that condition are put to bed. We have allowed the internist to take care of that end of the problem and to manage it in his own way. As soon as patients begin to show improvement from the irradiation, the adjuvant treatments are discontinued because they are not necessary.

If the disease is due to other factors in the patient's body, it would seem very queer that with such a high percentage of cases and from so many different men who make reports, that our final results should be in such close agreement, in spite of the fact that we have only treated the thyroid gland.

I have not followed my cases for five years. I do occasionally keep a patient under observation for five years, and even longer, after treatment. The results have been consistent and have stood the test of time. We generally keep a check on patients for at least one year. We never report a case as cured until it has been at least one year well from the date of the last treatment.

I can perhaps answer Dr. Voyles' question by referring to Dr. Bram's discussion. We do not use iodine because we feel that iodine is only a transitory benefactor and if we continue it beyond that point we only end up by giving the patient another disease, such as gastroenteritis. We do use quinine bromide for a short period. The dose is five grains, three or four times a day. You will find that patients that have had difficulty in taking quinine preparations before they had toxic goiter will be able to take tremendous doses without any symptoms of poison from quinine.

Cases must be carefully selected. If you do not do that you will not get the proper results. We treat only three distinct groups. One is the type

of goiter that in addition has a rapid pulse, a tremor, a loss of weight, an exophthalmus, and so on.

The second is the group of hyperthyroidism that show typical symptoms of thyroid intoxication but have no thyroid tumor.

The third is toxic adenomas in different parts of the thyroid gland, together with thyroid intoxication. We do not treat any non-toxic types. You cannot get at them well. I believe those cases are truly surgical. Of course, the small non-toxic thyroids do not necessarily have to have anything done to them, but if the tumor is large enough or is disfiguring enough to warrant it, surgery, I believe, is the best method of treatment.

Dr. Carr asked about beef blood: I never had any experience with that. In fact, I never heard of it until today. I shall certainly look it up and see what virtue there is in it and try it out. Any method that will help I will gladly acknowledge.

UNDER WATER THERAPY IN ARTHRITIS *

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Underwater therapy has been developed to a highly scientific degree in the after treatment of anterior poliomyelitis, but its use in other fields is in its infancy.

Inasmuch as this type of work requires special apparatus as well as specially trained technicians, the opportunity for properly directed research in this field has been limited. Theoretically the therapeutic possibilities of the underwater tank embrace not only the underwater reduction of dislocations but also the treatment of virtually all chronic joint diseases.

Arthritis presents a wide field for its exploitation. Its application to the chronic osteoarthritic patient has proved of inestimable value. For restoration of function in subdeltoid bursitis, remarkably rapid improvement may be demonstrated. In fact, it is of great value in most cases of impaired joint function. Although the thermal factor in many cases plays a curative rôle, it must be appreciated that underwater therapy is a valuable adjunct but not the sole therapy to be relied upon in most types of chronic arthritis.

In the after treatment of anterior poliomyelitis, it has been established that the optimum temperature of the water in underwater therapy is in the neighborhood of 86 degrees F. In arthritis this is not, however, the case. Notwithstanding that the type of therapy must be varied with the individual needs of the patient, it must be considered that in arthritis generally there is not only an impaired local circulation in the joint or joints but also a general lowering of the skin temperature.

Arthritics, regardless of type, do not tolerate with comfort underwater therapy in a tank at 86 degrees F., but require much warmer temperatures. The flexibility of temperature control in the large tank or pool for the treatment of anterior poliomyelitis is inadequate for the satisfactory treatment of chronic arthritics, hence the Hubbard tank with a thermostatic control as shown in the accompanying photograph is much more practical for the treatment of arthritis than a larger pool (Fig. 1).

Description and Operation of Apparatus

The tank which I am using is a specially built one, 7½ feet in length, with an arm span of 7½ feet. It permits the technician to reach the axilla of the patient on either side without entering the tank. The patient is enabled to relax with the head on an adjustable, air-cushioned, built-in head rest. The tank provides complete range of motion of all of joints of the body. It has three large inlets for water and one large drain pipe at the foot. It is equipped with a thermostatic control valve which is capable of producing a rapid change in the temperature of the water. In fact, it can be completely filled or emptied with water at any temperature in less than five minutes.

If an arthritic is so incapacitated that he cannot enter this tank unaided, he may be

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swung in a hammock from an overhead crane and lowered, or he may be lifted by several attendants into the tank. The temperature of the water in the tank on admission should be at approximately that of the body or slightly warmer, and should be gradually increased until the patient achieves maximum relaxation. This is usually accomplished by a temperature of 101 to 104 degrees F. This water temperature is gradually lowered to the point of individual comfort and tolerance which usually ranges between 96 and 98 degrees F. At this temperature, relaxation is best obtained as characterized by vaso-dilatation of all of the skin capillaries. The pulse and blood pressure should remain at approximately normal or only slightly elevated. There should be a slight increase in the basal metabolic rate while the patient is immersed, and a concomitant mild diuresis.

The treatment should accelerate gastrointestinal elimination and in some cases promote diaphoresis. There should be a definite increase in the oxidation process in the tissues as well as through the lungs, and a slight tendency to reduction in the blood sugar level as well as the uric acid and urea nitrogen content of the blood.

The white blood cells show a slight tendency to increase following the treatment, but there is not the pyrexial action analogous to protein shock therapy which occurs in more strenuous hydrotherapeutic procedures. There is a temporary increase in the red blood cells, but repeated treatments do not show the tendency to produce anemia as is the case with hydropathic measures which strive to achieve a hyperpyretic state.

The relaxation greatly relieves muscle spasm and pain. After the patient is completely relaxed, in the cases with joints which are painful on motion, it is advisable to proceed slowly with attempts at active motion, and confine one's self at first to massage beginning with gentle stroking towards the heart (effleurage). Subsequent to such gentle treatments, which tend to increase of tonus of the muscle and the general and local circulation of the patient, petrissage or gentle kneading towards the heart and graduated degrees of passive motion of the joints are instituted.

As the muscle tone of the individual continues to improve and greater degrees of passive motion are tolerated without discomfort, the patient is encouraged to undertake active motion and underwater exercises. When a good range of active motion is achieved and the patient is able to take regular underwater exercises, resistive exercises are given which aid in building even greater muscle tone. At this stage, the patient may swing in a belt supported from an overhead track and can actually go through a complete range of joint movement by attempting swimming maneuvers.

There are several factors which mechanically aid arthritics in this form of therapy. Anyone who has attempted to lift a heavy rock under water can well appreciate the advantage which the buoyancy of water gives these patients in combating the factor of gravity. If one would attempt to move a heavy rock under water and in the air, one will realize the tremendous lessening in the friction which is present and with what little effort motion may be accomplished under water in comparison with that required on an ordinary massage table. To demonstrate the advantage in combating gravity under water, you will find that you can easily maintain yourself lying on your back slightly under the surface of the water, supporting yourself merely on your index fingers. By the addition of salt to the water, the buoyancy may be even further increased — to the point where the individual will almost float.

The maximum benefit in increasing muscle and joint function and in the prevention and correction of joint adhesions in chronic arthritics can be attained only by regular, systematic treatment preferably daily, because the benefits are definitely cumulative if the therapeutic efforts are sufficiently systematic. Unless the treatments are given daily, the tendency to retrogress during the interval between treatments is too marked to achieve noteworthy success. Usually rapid changes are noted and the beneficial effect experienced by the patients even in the first treatment is often so impressive that they are greatly encouraged. They are only too willing to cooperate, and to many whose morale has been badly shaken, a new lease on life is given, when the enthusiasm of the patient in itself forces them to bend every effort to cooperate in restoring their joint function.

There are certain cautions which must be considered in dealing with these patients. The first and foremost is to avoid over-fatigue. In the initial treatments one should be extremely

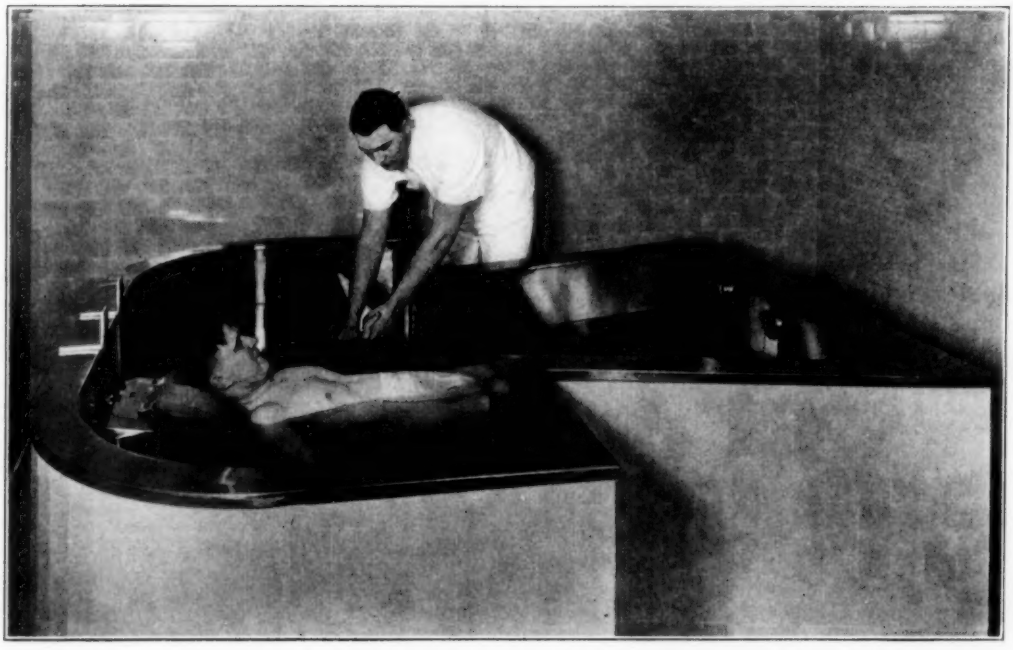

Fig. 1. — Hubbard Tank

careful that the duration of strenuousness of the treatment should not cause the patient to complain of fatigue after the treatment. By careful observation and records of the effects of each treatment, it is not difficult to gradually accomplish more with less effort and still avoid over-fatigue. The next most important consideration is the avoidance of causing pain. To attempt to move a joint when pain is involved not only discourages the patient with what should be a pleasant treatment and materially injures his morale, but actually aggravates the condition in the involved joint.

Importance of Trained Technicians

Trained technicians are most important. The technician must be capable to follow the prescription of the physician in carrying out the specific training of atrophied muscles and muscle groups. The technician must be capable of keeping a record of the function of each muscle or muscle group which has become atrophied from disuse or disease, and for which he has a prescription from the physician to train for restoration of function. He must be capable of appreciating what would constitute fatigue not only for the individual as a unit but for the specific muscle or muscle group. He must be trained in courtesy, sympathy and gentleness, all of which are so essential to the arthritic with a weakened morale and a profound neurosis.

This particular form of therapy is one which cannot be used empirically with any degree of success, but depends upon the intelligent prescription of the physician suited to the patient's specific requirements. The type of patient who has, in my experience, been the recipient of the greatest benefit, is the elderly one with osteoarthritis, who has been completely discouraged about therapeutic results for his or her pain and stiffness. Although no cure can be given by this method, the relief of their pain and stiffness and the restoration of function which can be accomplished in a period of a few weeks, is so gratifying that they are only too pleased to repeat such a course of daily treatments every six months or year.

Although the patient with rheumatoid arthritis can be greatly benefited by other forms of physical therapy, this particular treatment is applicable in cases where the active disease has subsided and the residual effects have not left the patient with ankyloses without the possibility of restoration of the joint function. But cases where ankyloses were only apparent, have been greatly im-

proved. Those individuals who suffer from impaired joint function following intracapsular fracture of the femur or following fracture of the neck of the humerus, or impaired function following sub-deltoid bursitis are, in my experience, materially benefited.

Undoubtedly there are numerous other types in which this therapy would be applicable and efficacious, and I am confident that time and research will elicit many other fields of usefulness.

Conclusions

1. Underwater therapy in arthritis is especially valuable in elderly individuals with chronic osteoarthritis, but is also valuable in advanced cases of rheumatoid arthritis, in sub-deltoid bursitis and in the after treatment of fractures impairing joint function.

2. The physiologic effects, although not as pronounced as in more strenuous forms of hydrotherapy, definitely stimulate the local and general circulation, as well as the metabolism.

3. Underwater therapy offers a means of preventing and correcting adhesions, of increasing muscle and joint function which cannot be equaled by any other therapeutic measure in the type of cases in which this therapy is applicable.

4. Rapidity of therapeutic results and its consequent improvement of the mental attitude of patients is conspicuous.

Hotel New Yorker.

Special Announcement

As this issue goes to press the Chairman of the Program Committee received a cable from Dr. Franz Nagelschmidt that he has accepted the invitation to participate in the program of the 14th annual session at Kansas City, September 9, 10, 11, 12, 1935.

Dr. Nagelschmidt will also participate in the instruction class, September 5, 6, 7, just preceding the annual program. The lectures to be presented by Dr. Nagelschmidt will include among others, the newer developments in diathermy and short wave therapy. Results of recent personal investigations in these fields will be offered for the first time.

This announcement of Dr. Nagelschmidt's proposed visit to the Congress sessions should be met with hearty enthusiasm by those who contemplate either registration for the instruction class or attendance at the annual scientific meeting. Further details of these programs will be given in the June issue of the ARCHIVES.

INDICATIONS FOR HYDROKINESITHERAPY *

(Underwater Therapeutic Exercise)

ALFRED B. OLSEN, M.D.

BATTLE CREEK, MICH.

It is difficult to say who discovered the new procedure of giving medical gymnastic exercise under water, but Dr. C. L. Lowman, in 1924, was among the first, if not the first, to use the treatment for infantile paralysis, of which he is recognized as the leading authority. He was instrumental in constructing a therapeutic pool in the Orthopedic Hospital of Los Angeles. About the same time Mr. (now President) Franklin D. Roosevelt, a victim of a severe attack of anterior poliomyelitis, in 1921, began under-water treatment in Warm Springs, Georgia, which he has faithfully continued annually or oftener, and with considerable benefit.

The Pools and Their Equipment

A few words about these special therapeutic pools may be acceptable. Ordinary swimming pools cannot serve the purpose of under-water exercise for two reasons, the construction of the pool and the temperature of the water. A good pool for a large hospital or sanitarium should be ten to fifteen feet wide and fifteen to twenty-five feet in length with a depth varying from two to four and a half feet. Smaller pools, such as the one devised by Dr. Hubbard, are also useful and less expensive. For very small children a large ordinary bathtub will suffice in many cases.

The temperature of the water is determined by the condition of the patient. When the muscles are sensitive and in a spastic state the temperature should be warm, about 97 to 100 degrees F. For the chronic or later stages of poliomyelitis and other conditions 86 to 92 degrees is satisfactory. Such temperatures have a gentle, bracing effect which is very pleasant. Low, easy steps and hand rails should lead into the pool, and it should be surrounded by a hand rail placed about four inches under the water and projecting into the water two or three inches so that it can be easily grasped. A variety of supports, such as chairs, reclining plinths and tables of suitable size and construction, placed so as to keep the head out of the water while the entire body is submerged, should be provided.

Theory of Treatment

Hydrogymnastics utilizes two of the most valuable healing agencies, immersion in water and exercise. The combination of the bath at a proper temperature with various manipulations and exercises under water is very effective in stimulating flabby or semi-paralyzed muscles and restoring their normal use.

The greatest advantage of under-water treatment is the buoyancy of the water and its efficiency in overcoming the force of gravity. The specific gravity of water is almost the same as that of the human body. This means that the natural weight of the body or any part of it is reduced to the minimum, and is almost completely carried by the sustaining power of the water. Few realize how much this means to weakened and paralyzed muscles that are apparently useless. The buoyant support of the water not only gives much greater freedom and ease of movement but also hastens improvement which, under the most favorable circumstances, must necessarily be slow and irregular. Another material advantage is the stimulating effect of the new treatment upon the patient's morale. Many who are more or less crippled with extreme weakness and paralysis become discouraged because of the slow and uncertain progress, and give up in despair. While this was often true of the old methods, the reëducation of the feeble and flabby muscles combined with the fine sustaining power of the water is a different matter. Very soon, perhaps at the first treatment, the patients find that they still have some control of an apparently useless limb, if only slight, and this discovery gives new hope and courage. Now they welcome the daily immersion and exercise and watch the progress with keen interest, for they see improvement. The treatment should be faith-

* Read at the Thirteenth Annual Session of the American Congress of Physical Therapy, Philadelphia, September 11, 1934.

fully persevered with as long as there is betterment.

The operator who administers the treatment requires special training for this important work. He should be familiar with the anatomy and physiology of the muscles and must faithfully carry out the directions of the attending physicians. It is necessary for him to have a pleasing personality and sound judgment.

Anterior Poliomyelitis. One of the most crippling of diseases and one which is confined very largely to children is anterior poliomyelitis or infantile paralysis. There is reason to believe that poliomyelitis accounts for a larger number of cripples, and more permanent disability and deformity than any other disease. Occasionally adults of all ages are affected. Until recent years the treatment has not been satisfactory although much benefit has resulted from skilful massage, medical gymnastics and electrotherapy. The introduction of under-water therapy marks a new era in the treatment of poliomyelitis and certain other disabling diseases. The buoyancy of water gives just the support that is needed in order to obtain the full benefit of muscle training. To get the maximum effect of this support, salt water, which has a higher specific gravity than fresh water, may be used. The buoyancy of fresh water can be raised seven per cent by the addition of sufficient salt.

Many patients who are suffering either from paralysis or from extreme weakness because of semi-paralyzed muscles become impatient and despondent. For the patient to watch the physiotherapist move the limbs in exercising the muscles and to realize that he can do nothing to co-operate is very disheartening. But the conditions are altogether different when the patient is properly immersed in the water. Now he finds with few exceptions that he still has some use of the apparently paralyzed muscles and that he can co-operate with the operator even though he cannot accomplish much. This gives him courage and increases his morale very materially. Treatment which previously had seemed useless now becomes desirable and worth-while.

Chronic Arthritis

Although hydrogymnastic treatment was first used in dealing with paralysis resulting from anterior poliomyelitis, it was soon found valuable for a number of other disorders, including chronic arthritis. During the past few years considerable success has followed the use of hyperthemia in the treatment of certain forms of this chronic and disabling disease. The high temperatures are obtained by subjecting the patient to infrared rays, incandescent light or hot vapor while lying in a suitable closed cabinet, or by the use of diathermy, the radiotherm or the inductotherm. In treating some of the more chronic and obstinate cases where the joints are rigid and semi-ankylosed, it has been found advantageous to give medical gymnastic exercise as soon as the patient is taken out of the cabinet. The extreme heat seems to have a relaxing and somewhat softening effect upon the hardened tendons and ligaments and the stiff joints so that movement is easier and less painful.

In some of these chronic cases I have used the ordinary hot full bath successfully. After the patient has been examined to ascertain his fitness for hyperthermia he is placed in the bath at a temperature of about 100 degrees F. with a cold compress to the head and an electric fan to add to comfort. The temperature of the water is gradually raised until the mouth temperature of the patient is about 102 degrees or a little higher. Then a skilful medical gymnast gives passive movements to the affected joints, slowly and deliberately. At the beginning, in very bad cases where the joints are almost completely fixed, the movement may be scarcely perceptible and somewhat painful. The exercise is carefully repeated, using a little more vigor each time, and the treatment is continued from ten to twenty minutes and later to half an hour.

In the early stages these movements are both trying and tiring to the patient and consequently must not be prolonged. Patients find this under hot water exercise more bearable and less painful than outside of water. The buoyancy of the water gives support to the weakened limbs and after a series of these treatments the patient is often able to make movements in the hot water that are impossible outside. The relaxing effect of the hot water and its anesthetic influence aid materially in restoring lost function, even though the progress is slow. On the intervening days between the hyperthermia treatments, the patient is given massage and carefully adjusted manipulations and movements of the stiff or ankylosed joints. It is not uncommon to no-

tice some improvement in the course of ten or a dozen hyperthermia and under-water movement treatments, so that the patient can walk with greater ease and with a less marked limp.

This treatment has been used successfully in treating certain chronic rheumatic disorders.

Other Conditions

Osteomyelitis has been treated by Brockway in a warm salt-water pool. Under-water (about 100 degrees F.) therapeutic exercise is indicated for some cases of spastic paralysis. Woodcock reports a case of spastic paralysis following fracture of the spine which was treated by under-water exercise. The warm water has a gentle, soothing effect which relieves the spasticity and permits movements and treatments which would otherwise be difficult or impossible. Here again much patience combined with persevering, skilful treatment is necessary for success. A neutral or tepid temperature, 88 to 92 degrees is recommended in treating flaccid paralysis.

Under-water medical gymnastics in the treatment of acute injury is recommended by Lowman, who reports a personal experience of this type. Movement of sore and painful muscles is easier under warm immersion. Gentle massage of painful parts is sometimes possible under water of the proper temperature. The warmth of the water has a distinct relaxing and soothing effect which promotes healing.

Patients recovering from a long-drawn out and exhausting illness which has confined them to bed for months face a protracted convalescence. The same is true of feeble and infirm people who are the victims of a grave accident or who undergo surgical operations. These patients often become exceedingly downhearted because of their extreme physical prostration and general disability. During the long confinement to bed the joints gradually stiffen and the muscles lose their tone and become flabby and almost useless. There is marked general debility and much physical prostration to overcome in rebuilding health. Many aged and worn-out people recover very slowly from serious sicknesses.

Here is a fertile field for hydrokinesitherapy. Some of these debilitated patients are too feeble and enervated to respond well to ordinary massage. Even gentle manipulation leaves their muscles sore and painful. They are too weak for medical gymnastics. But under-water therapy is a different proposition. Here a comforting bath is combined with skilful massage and carefully graduated active and passive joint movements. Exercise which out of the water was impossible or barely appreciable is readily performed with the assistance of the gymnast. The supporting buoyancy of the water is just what they need to make the kinesitherapy a success. Rigid joints gradually become supple while the muscles gather tone and strength. Suitable medical gymnastic treatment under warm water is a boon to many of these patients as their recovery is materially hastened. Usually a neutral temperature of the water, which is neither warm nor cool but just pleasantly comfortable, suits them best. It is heartening for many of these patients to begin walking in water of suitable depth and this they can sometimes do when they are otherwise too weak to even stand alone.

Patients who have suffered from some serious bone fracture or other grave injury can often be given massage and therapeutic exercise under water sooner than would otherwise be possible. In many cases warm water with a temperature of 100 degrees or higher is indicated. Manipulations of the muscles and other tissues and movement of the joints which would be unbearable ordinarily can be made with comparative ease and comfort when they are submerged in water of the proper temperature. Early treatment will hasten the healing of the wounds and shorten what otherwise might be a very slow and tedious convalescence.

Under-water exercise has been recommended for some of the later stages of multiple sclerosis when through weakness, ataxy and spasticity the patient becomes almost helpless. He may be able to walk in the pool while he is unable to even stand outside. Persevering exercise under the direction of the physician often brings at least temporary relief and sometimes a remission of the worst symptoms.

Faulty postures and some types of scoliosis and other curvatures of the spine may be successfully treated by hydrokinesitherapy, provided it is given by a competent trained gymnast and the patient perseveres with the exercise for a sufficient time. Patience and persistence are necessary for success.

Hydrokinesitherapy should be available in

all of our hospitals and health institutions and should be used daily in dealing with a large number of patients whose convalescence for one reason or another is very slow. To alleviate aches and pains submersion in warm water alone gives prompt relief, and when the bath is combined with very gentle massage and exercise suited to each case, the results are equally gratifying.

Among the diseases and disorders that have been successfully treated by under-water therapy may be mentioned:

1. Poliomyelitis, especially in the chronic stages, and after operation.
2. Spastic paralysis.
3. Flaccid paralysis.
4. Multiple sclerosis.
5. Chronic arthritis.
6. Paralysis from fractured spine.
7. Congenital hip dislocations following reduction.
8. Spinal fusion cases for Pott's disease.
9. Fractures.
10. Various bone and joint plasties.
11. Hip, knee and other arthrodesias.
12. Certain post-operative cases.
13. Osteotomies.
14. Bone grafts.
15. Scoliosis and other curvatures of the spine.
16. Faulty postures.

Summary

Under-water therapeutic exercise is the treatment of choice for the chronic stage of anterior poliomyelitis and various spastic and flaccid paralyses. It is also an excellent therapy for many disabling and crippling disorders such as chronic arthritis and for some traumatic conditions. Convalescence from certain exhausting diseases is hastened by hydrogymnastics.

The chief advantage of this new treatment is the combined immersion and the buoyancy of water which allows muscular movement and the use of limbs under water that elsewhere would be impossible.

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ARCHIVES of PHYSICAL THERAPY, X-RAY, RADIUM

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL THERAPY

Editor: DISRAELI KOBAK, M.D., CHICAGO

EDITORIALS

SPECIAL ANNOUNCEMENT

COURSE OF INSTRUCTION TO PRECEDE 14th ANNUAL SESSION AT KANSAS CITY

The program committee has completed arrangements for a course of instruction in physical therapy to be held just preceding the 14th annual session. The course will be intensive in character, extending over a three day period, September 5, 6, 7, 1935, and will be given in the Convention headquarters, the Kansas Citian. These arrangements have been made in compliance with a demand from numerous busy practitioners and technicians who do not find it feasible to go to metropolitan centers for postgraduate instruction over long periods. As the annual session will extend over a four day period, a full week of study in physical therapy is made available to those who wish to brush up in the work. Every branch of physical medicine will be covered including diathermy, short wave diathermy, infrared, ultraviolet, low voltage currents, hydrotherapy, massage and corrective exercise. Special subjects such as fever therapy, iontophoresis, electrosurgery, cancer therapy and electrodiagnosis will also be included.

Lectures and demonstrations will be given by teachers and clinicians who have earned recognition by their outstanding work in the physical therapy science. It is planned to limit the enrollment and for this reason early registration is solicited. Registration will be recorded in the order in which applications are received and no applications will be accepted after the required number of enrollments is obtained.

A fee of $20 will be charged non-members and technicians, and $15 members of the Congress in good standing. Applications should be accompanied by a remittance of $5, the balance to be paid not later than August 1, 1935. No enrollment will be made without the initial remittance.

The list of instructors and the schedule of the course will be published in the June issue of the ARCHIVES.

The committee is going to extremes in presenting this postgraduate study. Probably never before has such an outstanding group of instructors been assembled as will take part in this program. The lectures will be conducted in typical didactic manner, but will be supplemented wherever possible by an adequate amount of illustrative material. There have been numerous advancements in the physical therapy field and these will be properly evaluated. Round table luncheons will be of a most interesting nature providing opportunity for informal discussion of many of the related problems in the work.

This course is intended primarily for those who are willing to cover a rather wide field in a limited time. The lecture periods will run from nine to six daily. There will be no evening sessions.

Those who contemplate registration are again urged to act at once.

Arrangements have been made with the Hotel Kansas Citian, for special low rate accommodations, but early reservations are advised.

For additional information, write to

Chairman, Program Committee,
AMERICAN CONGRESS OF PHYSICAL THERAPY,
30 North Michigan Avenue,
Chicago, Illinois.

THE BORDIER TREATMENT OF ANTERIOR POLIOMYELITIS

The depressing picture of the ravages of infantile paralysis has etched itself upon the consciousness of the medical and lay world to such an extent that every available means has been marshalled toward its control. Unfortunately, the limitation of our remedial measures has led to a form of routinism which has scarcely proved as effective as has been hoped. Unquestionably progress has been made throughout the entire range of study, and while modern management has greatly assisted in overcoming the handicap of the patients so conspicuous in the post febrile stage, we cannot as yet boast of uniform, decided and permanent result — the ideal of medical practice.

It is therefore rather surprising that an effective method of treatment, such as devised by Bordier of France, has been allowed to go unnoticed in this country when authoritative clinicians in Latin Europe have reported striking and consistent therapeutic results in cases which were at all amenable to any form of treatment. Bordier offers no panacea, nor a specific, but reasoning on a sound patho-physiologic basis he utilized not one physical remedy, as has been the practice in the past, but judiciously availed himself of the energies of roentgen rays and of diathermy in combination with galvanization, to accomplish more than mere symptomatic relief.

There is nothing new in the measures as such, but in the properly combined and in the properly timed applications he has obtained results which would otherwise correspond with single systems of treatment too well known to need enumeration. The secret of his success and that of other observers mentioned in his article elsewhere in this issue, lies in the chronologic arrangement of his triad. In substance he utilizes radiation as soon as possible after and even during the so-called febrile stage, by which procedure he aims to attack the principal lesions in the spinal cord. Once having produced a resorption and resolution of the results of the inflammatory processes, he attacks the peripheral phenomena in a logical manner. Appreciating that atrophied muscles with poor circulation cannot respond to electrical stimulation to the extent seen in more normal tissues, he avails himself of the thermic and hyperemic qualities of diathermy to raise the affected structures to a state during which they will be most benefited by proper galvanic stimulation.

What is particularly interesting is that Bordier's method involves agencies which are available to virtually all patients without involving hospitalization. Under present economic conditions especially in consideration of the necessity for rather prolonged treatment by other accepted methods, Bordier's technic offers great advantages under any circumstances, the only possible condition being the need for cooperation by a competent radiologist. When however one observes the splendid therapeutic results obtained in a comparatively short period, this cooperation should not mitigate against the extensive use of the three agencies in the sequence advocated by this pioneer. In the light of the sad experiences with all the recognized methods of treatment to which must be added the need for underwater exercises involving prolonged sojourn in special sanatoria one might well wish that the profession in America had sometime since availed itself of the procedure advocated by the French scientist and physician. The complete restitution of muscular function pointed out in this report certainly causes regret that many important personages who are more or less physically handicapped by the ravages of anterior poliomyelitis were not afforded the benefit of a system of treatment so promising in its effectiveness.

THE CONTROVERSY ABOUT SHORT WAVE THERAPY

The history of medicine is replete with evidence that the most valuable discoveries and innovations in its diverse disciplines were at first received with satire, criticism and negation. This more or less general attitude of the medical profession has also proved an effective check against pseudo-scientific claims. It is, therefore, not surprising that short wave therapy, which is beyond doubt a real innovation in high frequency practice, should have not only enthusiastic sponsors but also earnest critics. In the light of past experience there is justification for a healthy skepticism, and recent contributions to the problems which appear to deny to short and ultrashort wave therapy the effectiveness claimed for it by a group of workers independent of each other and separated by different lands, merit tolerant and critical consideration.

Science does not err, but scientists do. Apart from the human equation it must not be overlooked that apparently contradictory findings may be ascribable to variations in technics or perchance to improper selection of wavelength or to differences in the energy output of the experimental apparatus. It hardly needs proof that under the varying factors in relation to certain reported experiments the present controversy is largely the result of lack of uniformity both with regard to apparatus and methods of research.

It is reasonable to assume that when investigators endeavor to verify the findings of an authoritative worker or groups of workers, one of their first considerations should be concerned with the exact duplication of the laboratory set-up of the latter. In this connection it is particularly convincing that when identical technic of experimentation was carried out identical results were obtained. Thus Pratt and Sheard,[1] of the Mayo Foundation, whose contribution appears in this issue, were able to confirm the deep thermo-penetrative powers of short and ultrashort radiation claimed by Schliephake,[2] Liebesny,[3] Holzer and Weissenberg,[4] and others. Study of this work discloses the fact that confirmation was attained when air-space electrodes were used instead of the commonly employed rubber condenser pads. As pointed out by the authors of the article,—

> . . . the relationship of the heat produced in deep-lying tissues to the heat produced in superficial tissues is dependent on the distance at which the condenser plates are placed with respect to the locations of the tissues. This fact is of importance in the therapeutic uses of high frequency fields. When a considerable air space separates these plates from the surface of the tissue, the change in temperature produced in the deep-lying intra-articular tissue is greater than that produced in the subcutaneous tissue. The converse relationship maintains when the plates are placed close to the surface of the tissue. This dielectric layer effect is superimposed on any specific heating due to difference in constitution of tissue and variation in wavelength of radiation which may be present.

It is evident that the above confirmation of the claims of Schliephake and other workers in this field was possible only by duplication of methods. It is therefore not surprising that Pratt and Sheard are also in accord with those who have demonstrated this type of depth effects of short wave fields, as contrasted with studies which utilized plate contact which can at best produce a heating effect predominantly superficial in character, similar or even less than that obtainable with diathermy.

It should also be emphasized that it has been shown beyond any doubt that under proper conditions and with sufficient intensities temperature may be greatly raised in deep structures without at the same time materially raising the temperature in the superficial parts. Phantom experiments by Gale[5] while not directly related to corresponding experiments on living material, are, nevertheless, significant as support of the widely published reports of a similar character. His findings based on experiments with electrolytes and with unicellular organisms show that short and ultrashort waves have selective thermic penetration.

But after all the average physician is especially interested in the practical utility of any remedial agent. Clinically, too, on account of lack of familiarity with the underlying principles and the correct methods of application, there was to be anticipated a diversity of results. Thus we have the spectacle of almost dramatic effects observed by some and the very opposite by others. Even accidental mishaps have not

been wanting. In this respect the profession has been materially benefited by the rather conservative statements by Krusen,[6] and by Turrell,[7] both of whom have pointed out possible danger of burns. These could of course be avoided if certain precautions, such as were enumerated in detail by Kobak,[8] were carefully observed. In substance Kobak stressed the importance of avoiding intensive heating, the removal of metallic objects from proximity to the patient, maintenance of adequate air space between the electrodes and the skin, and, when indicated, resort to glass electrodes for superior depth effects, with interposition of absorbent materials to reduce the possibility of sweat formation and to enhance insurance against sparking, overheating, and resulting burns.

Wilson,[9] who has studied Schliephake's precision of technic in his clinic in Giessen, stresses the fact that certain wavelengths are apparently more useful for certain conditions, so that one and the same wavelength cannot be utilized for all types of diseases at all suitable for this therapy. From this author's observations it becomes clear that our difficulties are principally due to the employment of short waves where ultrashort waves are indicated and vice versa. With proper selection of wavelengths and intensities this author reports excellent clinical results, unattainable by other methods of therapy. Similar reports from creditable sources are not wanting in the contemporary literature.

From what has been said there can be no doubt that short and ultrashort wave therapy offers possibilities which cannot be ignored. The present controversial points will in due time bear natural fruits when cultivated by exact and uniform laboratory and clinical studies.

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FIFTH ANNUAL FEVER CONFERENCE

The Fifth Annual Fever Conference met at Dayton, Ohio, on May 2 and 3, and unquestionably provided the most elaborate demonstration of the progress and value of pyretotherapy as practiced in America. It represented the culmination of five years of assiduous and self-sacrificing efforts of a small group of sincere students who had the imagination and the perseverence to transform an ideal into a therapeutic procedure rich in promise. The palm of distinction for special labor in this field must be accorded to many, particularly the contributions of such keen minded men as Whitney and Kettering in relation to the perfection of hyperthermic agents of finest precision; group workers at the University of Rochester led by Carpenter, Warren and Boak; Columbia University with Bierman; the Mayo Foundation with Desjardins, Hench and Sheard; and the inspirational labors of Simpson and his group of workers at the Miami Valley Hospital of Dayton.

Of Simpson's contributions in this promising field of therapy much can be said in high praise of both his personal and scientific qualifications since the scientific spirit of the session derived its most stimulating moments from the unselfish support and untiring labors of this worker. The many clinical and laboratory studies reported at this conference by means of the special hyperthermic apparatus under his control was the result of planned education and philanthropic support of the Kettering Foundation. At Dayton he assumed the dual function of a generous host and a scientific leader.

It is, of course, impossible to summarize the conclusions of 41 papers and of as many discussions, and we must therefore remain content with the salient ideas which may be

regarded as the consensus of opinion expressed at the conference. These may be formulated as follows: (1) Generalized fever therapy is an important adjuvant to scientific medical practice with increasing indications for its use. (2) Fever therapy is an heroic form of therapy, to be employed under intelligent supervision by regular physicians for only those pathologic states in which a stimulation of metabolic activity promises to provoke physiologic restitution. (3) A production of a generalized fever of 105 degrees F. and its maintenance for about five hours at each séance appears to bring about the best therapeutic results. (4) The hours of treatment and their sequence depend upon the results desired and rest largely in the hands of the experienced physician. (5) To insure against untoward accidents during treatment, a complete check up of the cardiovascular system prior to treatment is imperative.

Clinically, generalized and prolonged hyperpyrexia treatments appear to have produced successful restitution in such a wide variety of chronic and acute affections that their mere enumeration would carry us beyond the limited space at our disposal. Perusal of the program published in the News Section of this issue will reveal a wide field of indications already discovered for fever therapy. Like other new or comparatively new procedures which are resting on a scientific foundation, the clinical importance of pyretotherapy can be evaluated only after years of trial and observation. The Fifth Annual Conference has clearly shown that in the affections in which it has been employed it has become a measure of superior effectiveness, outrivaling other therapeutic means which in their time were hailed as valuable innovations. From the contributions presented at the conference it can be predicted with reasonable certainty that the pioneers in this field will in the near future still more enrich our therapeutic resources.

SCIENCE, NEWS, COMMENTS

Program of the Fifth Annual Fever Conference at Dayton, Ohio, Thursday and Friday, May 2 and 3, 1935

Thursday Morning Session

Report on Hyperpyrexia in Tuberculosis as Carried out at Glen Lake Sanatorium. *George W. Duncan,* Glen Lake Sanatorium, Oak Terrace, Minnesota.

The Thermal Death Time of 130 Strains of Neisseria Gonorrhoeae. *R. A. Boak, C. M. Carpenter,* and *S. L. Warren,* University of Rochester School of Medicine and Dentistry and Strong Memorial Hospital, Rochester, New York.

The Basic Principles for the Cure of Gonococcal Infections by a Single Fever Treatment. *S. L. Warren, C. M. Carpenter,* and *R. A. Boak,* University of Rochester School of Medicine and Dentistry and Strong Memorial Hospital, Rochester, New York.

Our Experience with Fever Therapy. *Arthur U. Desjardins,* Section on Therapeutic Radiology, Mayo Clinic, Rochester, Minnesota.

Results of Fever Therapy for Gonorrheal Arthritis, Chronic Infectious (Atrophic) Arthritis, and Other Forms of "Rheumatism." *Philip S. Hench,* Mayo Clinic, Rochester, Minnesota.

Results of Fever Therapy in Acute and Chronic Arthritis. *Robert M. Stecher,* Cleveland Clinic, Cleveland, Ohio.

Experience with Fever Therapy at the University of Colorado Medical School and Hospitals. *Franklin G. Ebaugh, Clarke H. Barnacle,* and *Jack R. Ewalt,* Colorado Psychopathic Hospital, University of Colorado, Denver, Colorado.

Some Unusual Cases Treated with the Kettering Hypertherm. *Eugene E. Simmons,* University of Nebraska, Omaha, Nebraska.

Preliminary Report of University of Nebraska Fever Research Project. *Bruce Austin* and *A. E. Bennett,* University of Nebraska, Omaha, Nebraska.

Treatment of General Paresis with Combined Electropyrexia and Tryparsamide. *Joseph R. Blalock* and *Leland E. Hinsie,* New York State Psychiatric Institute, New York City.

Thursday Afternoon Session

Report on the First Year of Fever Therapy at the Milwaukee Hospital. *Hans W. Hefke,* Milwaukee, Wisconsin.

Gonococcal Infection in the Female Treated by Means of Combined Systematic and Additional Pelvic Heating. *William Bierman* and *E. A. Horowitz,* Beth Israel Hospital, New York City.

Electrocardiographic Studies During Hyperpyrexia. *William Bierman* and *H. Vesell,* Beth Israel Hospital, New York City.

The Treatment of Gonococcal Infections in the Male with Pyretotherapy. *T. B. H. Anderson, R. C. Arnold,* and *J. A. Trautman,* U. S. Marine Hospital, U. S. Public Health Service, New Orleans, Louisiana.

Experiences with Tryparsamide, Malaria, and Diathermy. *Harry C. Solomon* and *S. H. Epstein,* Boston Psychopathic Hospital, Boston, Massachusetts.

Experiences with Fever Therapy in (A) Chorea and (B) Gonorrheal Arthritis. *Truman G. Schnabel,* Philadelphia, General Hospital, Philadelphia, Pennsylvania.

Chloride and Water Metabolism in Patients with Artificial Fever. *M. J. Lapore,* Department of Medicine, Duke Hospital, Durham, North Carolina.

Thermal Changes Produced in Various Tissues of Animals by Systemic and Local Applications of Radiothermy. *Charles Sheard, Ph.D.,* Division of Biophysical Research, Mayo Foundation, Rochester, Minnesota.

Therapeutic Effects of Electrically Produced Fever in the Treatment of Arthritis. *Charles F. Tenney* and *William B. Snow,* Fifth Avenue Hospital, New York City.

The Physiologic Response of the Hemopoietic Tissues to Artificially Induced Fever. *Charles A. Doan* and *M. M. Hargraves,* Department of Medical and Surgical Research, Ohio State University, Columbus, Ohio.

A Preliminary Report on Early Experiences with the Kettering Hypertherm at the Milwaukee County Hospital. *William J. Egan* and *Ray Piaskoski,* Milwaukee, Wisconsin.

Friday Morning Session

The Effect of Accurately Controlled Artificial Fever on Acute Tuberculosis. *R. C. Major, H. P. Doub,* and *F. W. Hartman,* Henry Ford Hospital, Detroit, Michigan.

Acute Pathological Changes Produced by Accurately Controlled Artificial Fever. *F. W. Hartman* and *R. C. Major,* Henry Ford Hospital, Detroit, Michigan.

A Case of Osteogenic Sarcoma Treated with Fever Therapy and X-ray Therapy. *H. P. Doub,* Henry Ford Hospital, Detroit, Michigan.

Organization of Fever Therapy Studies at University of Michigan Hospital. *Willis S. Peck,* Assistant Professor, Department of Roentgenology and Physical Therapy, Ann Arbor, Michigan.

Statistical Methods Employed in Fever Therapy Studies at University of Michigan Hospital. *H. M. Pollard,* Medical Statistician, Ann Arbor, Michigan.

Results of Fever Therapy in Pelvic Inflammatory Disease. *Carl P. Huber,* Instructor, Department of Gynecology and Obstetrics, University of Michigan Hospital, Ann Arbor, Michigan.

Results of Fever Therapy in Arthritis. *Cyrus W. Strickler,* Instructor, Department of Internal Medicine, University of Michigan Hospital, Ann Arbor, Michigan.

Results of Fever Therapy in Intrinsic Intractable Asthma. *John M. Sheldon,* Instructor, Department of Internal Medicine, University of Michigan Hospital, Ann Arbor, Michigan.

The Treatment of Thrombo-Angiitis Obliterans with Artificial Fever. *Fred Watts,* Harper Hospital, Detroit, Michigan.

The Treatment of Subacute Bacterial Endocarditis with Excessive Hyperpyrexia. *Hugo A. Freund,* Harper Hospital, Detroit, Michigan.

Observation on the Thermal Death Point of the (A) Streptococcus Hemolyticus, and (B) Streptococcus Viridans. *Hugo A. Freund* and *Fred Watts,* Harper Hospital, Detroit, Michigan.

Friday Afternoon Session

The Present Status of Fever Therapy for Dementia Paralytica in the State Hospitals of Illinois. *R. H. Kuhns,* Chicago, Illinois.

The Use of the Electric Cabinet as the Source of Heat for the Production of Artificial Fever in the Treatment for General Paresis and Chorea. *Emil T. Hoverson,* Chicago, Illinois.

Studies of Blood Picture Before and After Fever Therapy. *Frank H. Krusen,* Department of Physical Therapy, Temple University Hospital, Philadelphia, Pennsylvania.

Summary of Investigations in Fever Therapy at the University of Cincinnati. *Julien E. Benjamin,* Assistant Professor of Medicine, University of Cincinnati, Cincinnati, Ohio.

Case Reports. *Matthew H. Metz,* Assistant Director, Department of Fever Therapy Research, University of Cincinnati, Cincinnati, Ohio.

Artificial Fever Therapy of Gonoccocal Arthritis. *H. Worley Kendall* and *Walter W. Webb,* Miami Valley Hospital, Dayton, Ohio.

Report of Progress in Fever Therapy Researches at Miami Valley Hospital. *Walter M. Simpson,* Miami Valley Hospital, Dayton, Ohio.

The Kettering Hypertherm. *Edwin C. Sittler,* Miami Valley Hospital, Dayton, Ohio.

Artificial Fever Therapy of Ocular Syphilis. *Arthur M. Culler,* Miami Valley Hospital, Dayton, Ohio.

Dr. Thorek Decorated by France

The many friends of our distinguished member, Dr. Max Thorek of Chicago, will be pleased to read that on April 24, the French Government officially recognized his philanthropic, artistic and scientific labors by bestowing upon him the decoration of the Cross of the Legion of Honor. The banquet tendered him was in itself perhaps the musical event of the week in Chicago.

Dr. J. S. Coulter on Program of Missouri State Medical Association

At the 78th Annual Meeting of the Association of the Missouri State Medical Association held at Excelsior Springs, Mo., Dr. Coulter read a paper on "Physical Therapy in Chronic Arthritis."

New York Physical Therapy Society Meeting

The regular monthly meeting of the New York Physical Therapy Society was held Wednesday, May 1, 1935, at the New York Academy of Medicine Building, where the following program was given:

New Apparatus — Vacuum Type Wave Generator of Faradic and Galvanic Current.....
.....*Richard Kovacs,* M.D.

I. Scientific Session

Ultra-Short Wave Penetration. Illustrated.....
.....*Conrad K. Gale,* M.D.
(By invitation)

Discussion opened by Mr. Morton Blumberg and Mr. Robert Winkler
(By invitation)

Special Announcement

The Lepel High Frequency Laboratories, Inc., 39 W. 60th Street, New York City, manufacturers of electrotherapeutic equipment, wish to announce that Messrs. Ernest & Mantell are no longer associated with them. The New York office is now in charge of Mr. Gunther Herz. The Lepel Company also wishes to announce that it is no longer represented in Northern New Jersey by the New York General X-Ray Co. The Professional Electro-Medical Co. is now in charge of this territory.

Mississippi Valley Medical Society Organized at Quincy, Illinois

A new medical organization to be known as the Mississippi Valley Medical Society was formally organized at Quincy, Illinois, on April 8. The sole purpose of the new society is to hold an annual meeting each fall devoted to intensive post-graduate instruction and conducted by the leading clinical teachers of the United States. The programs will be eminently practical and of particular interest to the general practitioner.

The society will especially appeal to the physicians of Illinois, Missouri, and Iowa, and the annual meetings will be held in cities on the Mississippi River in these states. The first meeting will be held in Quincy during the month of October or November and will be a three-day session. The society has already been approved by the Adams County Medical Society of Illinois (Quincy), and the Marion-Ralls County Medical Society of Missouri (Hannibal).

The control of the organization is in the hands of a Board of Directors, consisting of one director to each 1,000 physicians in the states of Illinois, Missouri, and Iowa. The officers elected to serve for 1935 are:

President, Dr. Walter Stevenson, Quincy, Illinois.

President-Elect, Dr. H. B. Goodrich, Hannibal, Missouri.

First Vice-President, Dr. H. P. Coleman, Canton, Illinois.

Second VicePresident, Dr. E. A. Cunningham, Louisiana, Missouri.

Third Vice-President, Dr. Wm. Rankin, Keokuk, Iowa.

Secretary-Treasurer, Dr. Harold Swanberg, Quincy, Illinois.

An Advisory Committee, including the following prominent physicians has been elected by the Board of Directors:

Dr. Walter Bierring of Des Moines, President of the A. M. A.

Dr. Allen Pusey of Chicago, Past-President of the A. M. A.

Dr. A. D. Bevan, Past-President of the A. M. A.

Dr. Malcolm Harris, Past-President of the A. M. A.

Dr. Charles B. Reed of Chicago, President-Elect of the Illinois State Medical Society.

Dr. E. Lee Miller of Kansas City, President-Elect of the Missouri State Medical Society.

Dr. Thomas A. Burcham of Des Moines, President-Elect of the Iowa State Medical Society.

Membership in the society will be open to all ethical physicians, it being a prerequisite that they hold membership in their respective state medical societies. In order to get started quickly, the Board of Directors has elected to place the membership fee and dues for the first year at only $3.00 and life membership at $25.00, provided these are paid before the time of the annual meeting. Charter membership will close July 1, 1935. Members will attend the annual meetings without payment of a registration fee.

The Board of Directors is desirous of securing one thousand physicians as charter members in order to provide a caliber of program at the Quincy meeting that has never been equalled in this section of the Mississippi Valley. Ethical physicians interested in the new organization are urged to communicate with Harold Swanberg, M.D., Secretary-Treasurer, 211-224 W. C. U. Building, Quincy, Illinois.

Seventh International Congress on Industrial Accidents and Diseases

The Seventh International Congress on Industrial Accidents and Diseases will be held at Brussels, Belgium, from July 22 to 27, 1935. The American Committee of the Congress is under the Chairmanship of Dr. Fred H. Albee, New York, for the Section on Accidents and that of Dr. Emery R. Hayhurst, Columbus, Ohio, for Industrial Diseases.

The American delegation to the Congress will sail from New York on August 8th and visit London, Amsterdam, The Hague and Paris and, optionally Budapest. Physicians interested in the Congress or in the medical tour in conjunction with it may address the Secretary, Dr. Richard Kovacs, 1100 Park Avenue, New York.

Obituary

The Congress wishes to announce the sudden passing of Dr. Joseph Henschel of New York. Dr. Henschel was also a member of the New York Physical Therapy Society.

THE STUDENT'S LIBRARY

KURZ- UND ULTRAKURZWELLEN. (Biologie und Therapie). (Short and Ultrashort Waves in Biology and Therapy.) By Priv. Doz. Dr. *Paul Liebesny*, Leiter der Physikalisch-medizinischen Abteilung des Physiologischen Instituts im Allgemeinen Krankenhaus in Wien. Paper. Pp. 208 with 90 illustrations. Price, RM. 8.50. Vienna: Urban & Schwarzenberg, 1935.

This contribution is an additional confirmation of the clinical and biologic value of short and ultrashort radiation and will unquestionably have a beneficial influence on the controversial discussions in contemporary literature. Liebesny not only reviews and gives due credit to the pioneers ersponsible for the advent of Hertzian short wave in therapy but presents a judicial and conservative evaluation of its physical and clinical possibilities. Within the space of five scholarly and highly crowded chapters, the author has presented a detailed and critical review of the most important studies of the biologic and therapeutic value of short wave radiation. Beginning with the history of the employment of hertzian short waves in medicine, the work has been so organized as to include discussions on the fundamental action of hertzian short waves — its difference from diathermy, its biophysical, physiologic and clinical effect on human and animal material — in relation to its selective and heat penetartion on the various organs and fluids of the body, as well as upon microorganisms and plant cultures. The importance of these preliminary studies is well appreciated and highly commendable, since it is the very corner stone upon which the future therapy by short waves must rest. The chapter on the therapeutic employment of the short hertzian waves will thus be read with better understanding and greater appreciation. This part of the work is detailed in description and comprehensive in exposition, covering as it does a discussion of a large variety of acute and chronic affections related to every specialty in medicine. The last chapter deals with technical and physical considerations of interest to those concerned with the construction and uses of short wave apparatus. The bibliography is detailed and brought down to date, the index is highly classified and practical. Both the author and the publishers deserve highest praise for a contribution scholarly, conservative, and artistic in its physical format. Its early translation into the English language is a practical necessity for those not conversant with the German tongue.

DIAGNOSTIK CHIRURGISCHER ERKRANGUNGEN MIT EINSCHLUSS DER DIFFERENTIALDIAGNOSTIK UND ROENTGENDIAGNOSTIK. LEHRBUCH FÜR STUDIERENDE UND AERZTE (Diagnostics of Surgical Diseases Including Differential and Roentgen Diagnostics. A Textbook for Students and Physicians). By Professor Dr. *Rudolf Demel*. Cloth. Pp. 863 with 847 illustrations. Price 30 Marks. Vienna (Austria): Wilhelm Maudrich, 1935.

There is no dearth of good text books on surgical diagnosis in any country and in any language, but the present volume contains so many valuable features that it stands out in a class of its own. To begin with x-rays have become so valuable in the diagnosis of many surgical affections that every surgeon must make use of them. It is of course impossible to overestimate the value of interpretations of x-ray pictures by an expert radiologist, but just the same every surgeon should have sufficient knowledge to evaluate radiologic findings both pre- and postoperatively, and this book offers under one cover the means to attain at least elemental knowledge of roentgen diagnostics so far as they concern surgical diseases. Another valuable feature of this monograph is that in all cases in which a given affection can be confounded with other symptomatically similar but pathologically different ones, the author presents a well thought out differential diagnostic study. The text proper is divided into eight sections, each of which has a number of groupings according to the classification of pathologic phenomena. The sections take up the human body regionally beginning with the head and terminating with the extremities. The division of the section discussing the diseases of the neck is here cited to show the general arrangement of the subgroupings: Malformations and congenital diseases, abnormal position of the head (torticollis), injuries (including aneurysms), inflammatory diseases of the skin and of the cellular tissues, neoplasms, diseases of the lymph glands, diseases of the thyroid gland. Under the last named groupings we find no less than fifteen subdivisions, among which we mention: Functional diagnostics and functional disturbances of the thyroid gland, parathyroid tetany, inflammation and malignancies of the gland, and the like.

Considering that this book has evidently been written to serve as a guide for students and general surgeons, one can only approve the author's plan to give direct and terse presentations in all more or less common affections and to restrict discussion of specialistic problems to established facts. Thus the diagnostics of brain tumors is disposed of in a very few pages while much more space is devoted to diseases of the scalp and skull, including neoplasms of all sorts. The surgical aspects of the diverse forms of epilepsy, to cite another example, are disposed of in three pages, but the data contained in this small

space are adequate. Indeed one notes with pleasure the author's ability to say in a few words what others would require long sentences. It is precisely by this linguistic economy that the book actually covers the entire domain of surgery including borderline affections. The illustrations, photographic, diagrammatic or reproductive of x-ray plates are very clear. Print, paper, and binding are of the highest quality. We recommend this book to all radiologists as well as general surgeons as an excellent guide to the diagnosis of all surgical affections.

THE PRACTICAL MEDICINE YEAR BOOK OF 1934: OBSTETRICS AND GYNECOLOGY. OBSTETRICS. Edited by *Joseph B. De Lee,* A.M., M.D., Professor of Obstetrics, University of Chicago Medical School, etc. GYNECOLOGY. Edited by *J. P. Greenhill,* B.S., M.D., F.A.C.S., Associate Professor of Gynecology, Loyola University Medical School. Series 1934. Cloth. Pp. 718. Price, $2.50. Chicago: The Year Book Publishers, Inc., 1935.

This 1934 year book is based upon 652 critically abstracted articles. The editorial comments are often key thoughts of scholarly analysis regarding contemporary progress in these fields of practice. The review of the obstetrical literature shows that there is keen interest in hormonal and chemical methods of diagnosing pregnancy. Some of these tests are new while others are improvements and revisions of older ones. The problem of vitamins in relation to pregnancy has occupied many contributors during the year. Many abstracts are presented on anesthesia and analgesia. One notes experiences of many investigators with a large list of drugs and newer ways of application. The literature on complications of labor, Cæsarian section, and hemorrhage is quite interesting. The section edited by Dr. Greenhill will likewise absorb interest. Newer or revised concepts on sterility and fertility are presented. Contraception will particularly appeal to the reader where the Ogino-Knaus methods are discussed. There are also many interesting abstracts on menstrual disorders, infections, tumors of the uterus and ovarian new growths that give rise to physiologic changes. Radium and electrophysics is a growing section, but the latter subject is still neglected, and many interesting articles on electrotherapy and surgery have been overlooked. The editors reproduced a number of original illustrations. This book is ever welcome to the specialist and the interested practitioner. The prodigious efforts of two important workers in obstetrics and gynecology places the world's literature within easy reach.

THE SPASTIC CHILD. By *Marguerite K. Fischel.* Cloth. Pp. 97 with illustrations. Price $1.50. St. Louis: The C. V. Mosby Company, 1934.

This is a book written by a mother of a spastic child with a message of hope to other mothers of similarly afflicted children. The author states that she was urged to write this book by the late Dr. Nathaniel Allison to show the methods of home treatment used and the progress this spastic child has made since his earlier years when he appeared doomed to lead the life of a cripple, to his rehabilitation in his sixteenth year. It is an important contribution to the treatment of spastic paraplegia as it contains the manifold particulars of the therapy of Little's disease. The physician will find this small volume instructive for himself, and of value to have the mother and nurse caring for a spastic child see how devoted care intelligently applied can rehabilitate an apparently hopeless cripple.

FRENCH MEDICINE. By *M. Laignel-Lavastine,* Professor of the Medical Faculty in Paris, Secretary General of the International Society of Medical History, and *M. Raymond Molinery,* Gold Medalist of the Academy of Medicine, Member of the French Society of Medical History. Translated by *E. B. Krumbhaar,* M.D., Professor of Pathology, University of Pennsylvania. No. 15. Clio Medica, A Series of Primers on the History of Medicine. Cloth. Price $2.50. Pp. 187 with 14 illustrations. New York: Paul B. Hoeber, Inc., 1934.

This volume traces the history of French medicine from the period of the first inhabitants of Gaul when, according to the art of the cavern walls, curative magic played a great rôle to the twentieth century. To those interested in physical therapy this history has special value, for the history of hydrology is intimately associated with French medicine.

During the Gallo-Roman period whenever warm springs were found in Gaul after its conquest by Julius Caesar the Romans established therapeutic baths. Mud baths were highly regarded in this period. The most frequented were Barbottan, Dax and Saint-Amans-les-Eaux. The most celebrated map of Peutinger of Vienna points out the itinerary that one should travel in France in search of the various waters. Vichy, Plombieres and many other waters are of Roman origin, but were broken up by the invasions of the Vandals, Saracens and the Goths.

The 15th and 16th centuries witnessed the Renaissance of thermalism and this volume gives an interesting history of their development to the present day. It is of great interest to note that a lively campaign for the creation of chairs of hydrology in the medical faculties has arisen, the first being created at Bordeaux in 1912.

The important part that French physicians had in the development of the use of high frequency currents in therapeutics is not mentioned. This is to be regretted as the name of d'Arsonval is known wherever high freuency currents are used. This interesting and scholarly presentation maintains the high standards of its predecessors in the series of primers on the history of medicine.

DISEASES OF THE EYE. By *Sir John Herbert Parsons,* C.B.E., D.Sc., F.R.C.S., F.R.S. Seventh edition. With 21 plates and 353 text figures. Pp. 695. Price, $5.50. New York: The Macmillan Company, 1934.

This book, published in its first edition in 1907, has now gone through seven editions. The author has made numerous additions and changes necessi-

tated by important advances in ophthalmology. The book is divided into seven sections and an appendix. An important section and one which usually is not included in a similar position in the average text is Section IV, devoted to errors of refraction and anomalies of accommodation. These subjects are adequately detailed and should prove of great interest to the student in particular. The subject of physiological optics has come to the fore in recent years. It is given due consideration. This chapter contains a wealth of information of practical value. In general the remedies and measures recommended for therapeutic application conform with those accepted by most ophthalmologists. In a few instances, however, the author's personal experience in the specialty is the basis for non-conforming suggestions. The plates and illustrations are indispensable for teaching. Every student appreciates their significance, especially when confronted with problems which the text in itself does not make completely clear. The fact that it has been revised for the seventh time speaks for its merits as an ophthalmic text book. The topography is easy to read. This work is a worth-while addition to any medical reference library.

HUMAN ANATOMY. Double Dissection Method. By *Dudley J. Morton*, Associate Professor of Anatomy, College of Physicians and Surgeons, Columbia University, 2 volumes. Pp. 1-265 and 270-554, profusely illustrated in text. Price $6.00. New York: Columbia University Press, 1934.

The double dissection method as expounded in these two volumes is the fruition of plans attempting to adjust the teaching of Gross Anatomy to a curriculum which is yearly becoming more crowded by the new advances in medicine as taught in our medical schools. The reduction of the allotted time for anatomy from the two year period to one, and the consequent abbreviation in the number of hours for this study has been met by concentration of the subject matter and the teaching of anatomical facts under more intensive schedules.

The Department of Anatomy of the College of Physicians and Surgeons, of Columbia University, has met the situation by a reorganization of its personnel and by developing in the past six years an effective plan which has proven eminently successful. Under the new schedule of 360 hours the student is provided with two dissections of the entire body, the first being limited to the larger structures and visceral organs, and the second chiefly to the "vascular and nervous systems with a review of the larger structures." Students are paired four to a table, the laboratory work being equally alternated between dissection and study of exposed structures. The lecture work is coordinated with the laboratory assignments one keeping pace with the other, and facilitating greatest orientation with the subject. Periodic tests enable both student and instructor to gage the progress and accomplishment of each. This concentration of purpose the author points out, has been a challenge to both and has brought out an earnestness of effort and resulting success that has compensated for the loss of time. It has taught self reliance, an "x-ray vision" to see the structures beneath the skin in their relative positions, and brought to the fore other desirable faculties. The foregoing volumes are intended as laboratory aides. Their purpose is to "guide the student through the intricacies of classic dissection but not as a replacement of textbooks, and to supply the student with an efficient and orderly plan of dissection, so that a maximum of time will be available for study of exposed structures . . . these directions to be complete and precise in order that the technical part of laboratory work will require little attention of the instructor, thus permitting the latter to employ their time more freely in amplifying physiological, developmental, and clinical considerations which sustain the students interest upon a more vital and purposeful plan." The double dissection plan as expounded by the author represents a distinct contribution in the study of anatomy and undoubtedly will become the future method of study in all progressive medical institutions in America.

MODERN TREATMENT OF FRACTURES. By *H. Waldo Spiers*, A.B., M.D., Professor of Orthopedic and Fracture Surgery, College of Medical Evangelists, Los Angeles, California. Cloth. Pp. 129 with 109 illustrations. Price, $2.00. Baltimore: The William Wood & Company, 1935.

The purpose of this work is to present the latest thoughts regarding the dangers and pitfalls, the "tried and true" methods of treatment, and the fundamental principles of all fracture surgery in the briefest space commensurate with its importance. It makes no effort to compete with the larger works on the subject. Indeed, the author's very purpose is to present the essential facts without sacrificing the unity of the subject. In the space of 129 pages there is presented a complete survey of the entire problem of fracture surgery, ranging from terse discussions of general considerations, such as the mechanics connected with various types of fracture infections, the nature and preparation of plaster casts, x-ray interpretations, methods of applied traction, manipulation, and the like. The author's conception of physiotherapy is distinctly vague and hence this part of the work is so sterile as to create a corollary thought as to whether the major discussion is not equally as inefficient. Fortunately, this has not been found to be the fact, the author showing commendable orientation in his subject, the general exposition reflecting a background of good preparatory training. Undoubtedly, in the abbreviation of this large and important branch of surgery to the present size, the author had the choice of either skimming the surface and adopting the dogmatic form of exposition, or the more detailed and laborious form associated with more voluminous texts. There is room for both styles of discussion, but even in the former method the reader should at least have been provided with a bibliographic reference as a direction for wider information on the many topics touch upon in this volume.

INTERNATIONAL ABSTRACTS

A Year of Short Wave Therapy. Justina Wilson.
Brit. J. Phys. Med. **9**:203 (March) 1935.

The favorable and often excellent clinical results reported by the author were due to the utilization of a rigid technic, similar to or approaching closely that taught by Schliephake. Wilson prefers the tube to the spark gap apparatus. The latter while useful for relief of pain, arthritis of the small joints and neuritis, "compared with the valve machine . . . has a very limited field of application and its energy output is inadequate for work in the ultrashort field, i. e., below 6 meters." A large variety of arthritis was treated. Cases of chronic arthritis of the spinal column were extremely benefited, cases that were even resistant to infrared, diathermy, and all other forms of physical treatment. One had, however, to resort to different wavelengths to obtain speediest results. Some responded best to short and others to ultrashort wave therapy. Rheumatoid arthritis was found to be the least responsive group, yet here also, notable symptomatic relief was obtained when the focus was treated. One such patient responded best when a 4.5 meter wavelength was used over the throat. This report includes observations of various forms of acute and chronic arthritis (infective, fibrotic, osteitic), neuritis, neuralgias, sciatica, certain abdominal conditions (hepatitis with gall bladder colic) salpingitis and other gynecologic disturbances, as well as furuncles, carbuncles, antra and sinuses, sprains, contusions, myositis, varicose ulcers, and certain types of resistant skin diseases as psoriasis, and the like. The author's experiences during one year of clinical study were so favorable as to advise: "Try it once. Having done so, you will adopt it and be surprised by its certain and rapid action" in those obstinate conditions not influenced by other methods.

Electroneurolysis in Therapy of Trigeminal Neuralgia. T. Fracassi, and F. L. Marelli.
Abst. in J. A. M. A. **103**:1492 (Nov. 10) 1934, from Rev. Med. del Rosario **24**:743 (Aug.) 1934.

Fracassi and Marelli treat essential trigeminal neuralgia by electroneurolysis with the following technic:

The patient lies on his back on a flat table with the head in such a position that the involved nerve forms the continuation of a vertical line with the needle introduced vertically. This position of the nerve in relation to that of the needle is obtained by the inclination or by the elevation of the patient's head without changing the position of his body and is controlled by the position of the foramen ovale and the foramen rotundum. To approach the inferior and superior alveolar nerves the patient's head is inclined in the first case and raised in the second case 15 degrees from a line horizontal to the axis of his body. The needle used is one of those commonly used for intramuscular injections, not exceeding 4 or 5 cm. in length. A fine insulated copper wire, which can easily pass through the eye of the needle, previously disinfected with alcohol, is used as a mandrin. The layer of insulating thread of the mandrin is removed at one end 3 to 5 cm., and a knot made in the mandrin as a mark to indicate the length which should be introduced in order to have its point pass the point of the needle. The other end of the wire is then connected to a galvanic current. A painful sensation of the patient, exteriorized by an involuntary gesticulation, indicates that the point of the mandrin is in contact with the involved nerve. The current is then stopped in order to perform the anesthetization of the nerve by infiltration of 1 cc. of a 2 per cent solution of procaine hydrochloride-epinephrine. Four or five minutes later the isolated mandrin is introduced down to the mark previously made on it. The other end of the wire is then connected to a galvanic current and this current is permitted to pass in a slow and progressive form until 5 milliamperes has been given during 3 to 5 minutes at each pole. The positive pole should be applied before the negative one, because the former one adheres to the nerve and it is detached from it only by the passage of a negative current. Because of the fineness of the mandrin, the galvanic current does not destroy the tissues of the nerve during the first application. A second application, given three or four days later with the same technic, results in the destruction of a new zone of the nerve and the complete disappearance of the pain. In the author's cases the pain has not reappeared up to the present time (six months after treatment). They advise resorting to alcoholization of the nerve with 2 or 3 per cent phenolated alcohol in cases in which the galvanization is impracticable. Phenolated alcohol is more efficient than absolute alcohol in these cases.

Diathermy in Hypertension. Trolow.
Abst. in J. A. M. A. **103**:21-1661 (Nov. 24) 1934, from Wiener klin. Wchnschr. **47**:1121 (Sept. 14) 1934.

Trolow and his associates are of the opinion that disturbances in the endocrine-sympathetic systems with subsequent regulatory disturbances of the entire vascular system and with vascular spasms of the abdominal organs play an important part in the pathogenesis of essential hypertension. They decided to apply diathermy to the celiac plexus and to the suprarenals. The position of the kidneys was determined and marked on the skin. Two electrodes, each 150 sq. cm. in surface, were fixed in such a manner that one-half of each electrode was

applied over the marked region and the other half reached beyond it into the region of the suprarenals. In addition to these two electrodes a third, of 300 sq. cm., was applied in the center of the epigastric region, immediately below the xiphoid process. In some cases this third electrode was replaced by two, each of them having half the surface and being placed over the lateral epigastric regions, below the costal arch. The treatments were given with a current strength of from 0.5 to 2 amperes. The patients were lying down when the diathermy was applied. The treatment lasted from five to ten minutes, and they were given daily or every second day. The total number was from fifteen to thirty, depending on the results. After each treatment the patients had to rest for about thirty minutes. The blood pressure, the pulse, the respiration and the general condition were determined before, during and after each treatment. Of the twenty-five patients treated in this manner four were not influenced, one showed a slight increase in pressure, but the other showed a reduction of the maximal pressure. The minimal pressure was reduced in fifteen cases. The reduction of the pressure that had been obtained by means of the diathermy persisted in some instances for from eight to ten months, while in others a relapse occurred after about two months. In two patients the blood pressure was higher three or four months after the treatment than it had been before. The frequency of pulsation and respiration remained generally about the same. The authors conclude that in the majority of cases the results were favorable and think that the treatment deserves further attention.

Secret Communications Made Visible. F. W. Martin, and Konrad Beothy.

Lancet **226**:1006 (May 12) 1934.

Criminologists have found filtered ultraviolet light a valued assistant in many spheres of their work. Investigations with these rays can be carried out expeditiously, and are simple in execution. Moreover, the test as applied by the analytic quartz lamp has the valuable advantage that the object under examination is in no way damaged, marked, or altered. Correspondence to and from prisoners can be examined in a few seconds by exposure to filtered ultraviolet light, since the substances commonly used by prisoners for secret writing — e. g., urine, saliva, milk, all show fluorescence to such exposure.

Specific Effects of Ultrashort Waves. T. Reiter.

Deutsche med. Wchnschr. **59**:160, 1933.

Ultra short wave diathermy, with a wavelength of less than 15 meters, exhibits two selective effects not observed with diathermy of longer wavelength. One is an inflammation caused by pronounced active hyperemia, limited exactly to the exposed area. The other effect is the destruction of malignant tumors at temperatures which usually cause no such results. This observation suggests specific effects not due to temperature increase.

The Effects of Short and Ultrashort Waves Upon Inorganic and Organic Compounds. (Über Einwirkung von Kurz-und Ultrakurzwellen auf anorganische und organische Verbingungen.) E. Hasche and H. Leunig.

Strahlentherap. **52**:179, 1935.

Several inorganic and organic substances, such as blood serum, egg protein, starch, metal colloids, phosphorus, silver chromide, barium-platino-cyanide, luminiscent dyes and atmospheric air, were examined concerning changes brought about in the condensor field by wavelengths from 3.5 to 21 m. Heat effects were excluded by a cooling device and by the selection of some substances which are not affected by heat. Even with exosures to excessive intensities over hours, in no case could a specific change, caused by the waves, be demonstrated.

A Surgical Ultraviolet Lamp as an Aid to the Removal of Dislocated Lenses. H. Rommel Hildreth.

Am. J. Ophthalmol. **17**:414 (May) 1934.

Dislocation of the crystalline lens into the vitreous is not a common condition, but when it does occur it is all-important to that patient. Sooner or later complications are the rule, secondary glaucoma being common, and it becomes necessary to remove the lens. Generally the removal of such a lens is a difficult procedure, chiefly because of the inability to locate the lens after the eye is opened. Opinions differ when such a lens should be removed.

The crystalline lens has the property of fluorescing under ultraviolet light, and when conditions of illumination are correct, the lens can be seen to glow brilliantly whenever it may lie within the eye. This phenomenon is present in both the normal and the cataractous lens. The rays most potent in this effect are those just below visible violet, or in other words, the long ultraviolet rays. These rays are inactive biologically and will not cause an ultraviolet burn. They also pass readily through ordinary glass.

The problem of using this phenomenon in the removal of dislocated lenses evolves itself into developing some simple, practical means of getting the ultraviolet into the eye. It would be desirable to direct the light into the eye with the patient on the operating table in the usual position for operating and to have the light under the control of the surgeon during the entire procedure.

In order to demonstrate the fluorescent effect, the greatest part of the visible light must be removed, but the ultraviolet rays must be left. This is done by using a violet glass that may be obtained from the Corning Glass Works of Corning, New York, under the trade name Heat Resisting Red Purple Ultra. This glass transmits a faint violet light, enough to enable one to observe the direction of the radiant beam. It transmits strongly in the long ultraviolet band but absorbs the short, biolgically active ultraviolet rays and also the heat rays. The glass is not unduly fragile and will withstand the heat from the arc.

A 2 inch diameter disc of this glass 3 mm. thick, together with a similar sized — 16 diopter cataract

lens, is mounted 4 cm. in front of the arc. A panel cut from ordinary sheet metal, with a central aperture to take the filter and lens, is attached to the front of the arc chamber. The arc that was chosen was a standard Bausch and Lomb product, used in microprojectors and therapeutic lamps. The lamp is mounted on a base with the beam pointing upward at a 45-degree angle.

It was considered unhandy and unsafe to have the lamp above the patient, pointing into the eye. In this position, moreover, the head of the surgeon would obstruct the beam of light. Therefore, the lamp is placed on a stand beside the operating table, below the level of the patient. The beam is pointed at the surgeon's head and is reflected into the patient's eye by an ordinary headmirror, which acts as a reflecting ophthalmoscope and places the light beam under control. A converging beam falls on the eye, the size and concentration of the field of light depending on how close the operator's head is to the eye. The faint violet light will be just noticeable in an ordinarily lighted room (the bright surgical light should be turned off while using the lamp), and when focused on the pupil it will cause no fundus reflex. The color of the fundus is such that violet light is entirely absorbed.

The lens will stand out brilliantly contrasted in a greenish glow, the margins sharply defined. With the head-mirror properly adjusted, one obtains good binocular vision. The lighting is such that the lens loop and other instruments are adequately seen.

The use of the lamp will be a distinct help at the moment of seeking the lens. The author prefers a thoroughly adrenalized pupil, Van Lint akinesia and retrobulbar injection of novocain.

Changes in the Central Nervous System Due to Electrocution. E. A. Blake Pritchard.

The Lancet **226**:1163 (June 2) 1934.

In a large number of cases of fatal electrocution it is certain that the current passed through or over the body is sufficient to produce somewhere in its path enough heat to account for severe damage to the tissues. The dilated spaces and tears in the nervous system may be produced by the expansion of gases liberated by electrolysis from the tissue fluids.

Hassin has examined the explanations given in terms of heating and of electrolysis and has rejected them on purely circumstantial grounds, i. e., on the absence of similar changes in cases of fatal hyperthermia and of caisson disease. He considers that the changes are "due to purely mechanical factors. The action of a strong electric current is equivalent to direct mechanical injury . . . a momentary violent jarring . . . the mechanical factor — the jarring — is the electric current."

It is not easy to decide what is the electrical state of affairs when a man is electrocuted either by lightning or by coming accidentally into contact with a conductor at high potential. The path of the current through the body can only be guessed at from a knowledge of the physical factors involved, and our knowledge even of the quantity and of the form of the electric energy supplied is in most cases uncertain. In the case of legal electrocution we know most about these factors, for we know the effective voltage, the resistance of the body, and the duration of the current. In the case of lightning stroke we know least — even the accepted physical views of just what is happening in the occurrence of a lightning flash have been profoundly modified twice in the last five years.

An uncharged conducting body which is brought into electrical contact with a charged conductor becomes itself charged and will remain at the same potential as the originally charged conductor so long as the contact is maintained. If now the conducting body which has been charged in this way be removed from the originally charged conductor and come into contact with yet another conductor at a lower potential it will share its acquired charge with the latter, e. g., if it be earthed, the acquired charge will all run to earth and the final potential will be that of the earth. But should this happen while contact with the originaliy charged conductor is maintained the conducting body which received the charge will continue to do so, and a current will flow through it to the earth.

Treatment of Frost Bites With Short Waves. Albert Burkmann.

Urol. & Cutan. Rev. **38**:778 (Nov.) 1934.

This author says that a perusal of the literature that he has had an opportunity to make up to the end of January, has shown that nobody so far has treated frost-bites with short waves. He says that even Schweitzer makes no mention of it and that only in Laqueur and Riza Remzi was he able to find a remark on a case of frost-bite symptoms following acrocyanosis treated with short waves, without, however, any improvement. "The suspicion is there, nevertheless, that frost-bites would fall into this field of therapeutics, even though the results were not favorable. Otherwise I have not discovered any reference to mal-results."

Ten cases of frost-bites were reported in which the Siemens-Reiniger apparatus was used, with very good results. Because of the sudden cold spell in the beginning and middle of December there were many frost-bites affecting the hands, feet and legs showing an infiltrative process as a reaction to the effect of the cold.

The technic employed was along the following lines: Upon a pad that is not too soft the condenser electrode is placed upon which is placed the finger (or toes) to be treated. If both hands (or feet) are involved they are placed crosswise over each other and the other electrode is placed on them. The whole is held in position by means of a rubber bandage and it is best to obtain a certain amount of compression by means of a sand-bag placed thereon, but without producing any ischemia. In most cases in order to keep the parts homogeneous, a layer of felt was inserted between the electrode and skin, the felt being about 5 mm. thick. In this position no danger is involved in the process.

To begin with, the treatment lasts 15 minutes, with rest intervals of four or five days; then it is increased to 20 minutes and even to 25 minutes. Usually but six treatments, very rarely more, were given. The author also reports three cases of erythrocyanosis crurum puellarum. In two of these patients, young girls, the first symptoms appeared

after skating in freezing weather without sufficient clothing. Results were obtained after two sittings and the cases cured after four sittings.

Pathology and Treatment of Sprains. Morton Smart.

Brit. M. J., **3849**:673 (Oct. 13) 1934.

The advocacy of rest as the principal treatment of sprained joints almost certainly originated from the natural tendency of the possessor of a sprained joint volitionally to place that joint in the position of greatest ease. But the direct result of trauma and the processes leading to repair is a great increase of internal pressure in the surrounding tissues, due to bleeding and pouring out of lymph, so that there is stretching and pressure on the tissues, particularly the nerve endings, and pain in injury is quite unavoidable. Hence treatment by rest became the recognized method but solely as a palliative.

The physiological changes called into play by muscular action promote a very active circulation of blood and lymph, not only to the muscles themselves, but to all the neighboring tissues. Muscle is a highly sensitive structure, with power instantly to respond to a variety of stimuli when in a state of health; when for any reason it loses its tone wasting follows rapidly. The loss of tone and the loss of power fully and rapidly to contract is of obvious importance to the security of a joint, and no joint can be considered to have recovered completely from injury to any of its structures until the tone and contractility of its musculature have been successfully restored to normal.

The effects of the treatment of injured muscles and joints by correct electrical muscle stimulation, which produces graduated and controlled contractions, and relaxations are: Muscle elasticity, irritability, contractility and toxicity are rapidly restored to normal.

A great increase of blood to the muscles and to the neighboring tissue is produced, with all the attendant beneficial consequences.

Waste tissue products are rapidly cleared away and stagnation of lymph, with all its serious sequelae is prevented.

A large supply of oxygen and nourishment is brought to the damaged part. Rapid absorption of fluid and extravasated blood is actively promoted.

If, in later stages, adhesions have formed, the adherent surfaces are gently but effectively torn apart by causing increasingly powerful contractions of the muscles separately.

Copper Ionization for the Treatment of Leucorrhea in Virgins. David William Tovey.

Am. J. Obstet. and Gynec., **27**:916 (June) 1934.

A special speculum is used which consists of a cystoscopic tube with a handle large enough for the patient to hold. Examination frequently reveals erosion of the os, the cervix swollen, and a mucopurulent discharge. With the patient well down on the table the instrument is introduced, and the cervix exposed and swabbed. Next the author's small sized copper intracervical electrode is inserted up to the internal os. A large indifferent electrode is placed under the back, and from four to ten milliamperes of current are given with the positive pole. After twenty minutes the current is turned off and the negative current used to release the electrode.

In case of pinhole os, the tip of the copper electrode is pressed against the external os, and the negative current turned on until the os dilates, after which the current is reversed and copper ionization given for twenty minutes.

Twenty-five virgins, from fifteen years of age to twenty-five have been treated for long standing leucorrhea. Most of these patients had been unsuccessfully treated by douching and topical applications to the vagina. Copper ionization proved extremely satisfactory. From four to eight treatments are necessary to cure the cervicitis. Treatment is painless.

Hematoporphyrin as a Therapeutic Agent in the Psychoses. Edward A. Strecker, and Francis J. Braceland.

Am. J. Psychiat., **13**:1157 (May) 1934.

Hematoporphyrin has a marked photosensitizing power when injected into the human body. The synthetic product, hematoporphyrin hydrochloride ("photodyn") possesses greater photosensitizing power than the compound endogenously produced through disease.

Experimentally the drug has been shown to produce alteration in the blood electrolyte values—chiefly calcium. One patient in whom blood calcium studies were made showed a definite fall in blood calcium during and after hematoporphyrin therapy.

Hematoporphyrin as a therapeutic agent in the depressive psychoses is reported in foreign literature to be successful in a large majority of cases, but carefully controlled study has not yet been done.

Thirty-seven patients were studied to determine their responses to hematoporphyrin administration. Twenty-three patients with manic-depressive reactions were treated during the depressed phase with intramuscular and oral administration of hematoporphyrin hydrochloride for an average period of 50 to 60 days. Of this number 5 showed marked sustained improvement, 6 showed moderate sustained improvement, and 6 were generally benefited, but the course of the psychoses did not seem to be positively affected. Six gave no favorable response. Seventeen patients of 23 can be said to have been definitely helped by the treatment.

Four of 8 patients suffering from involutional melancholia showed marked improvement. One was moderately improved and has maintained this gain. Two were generally better during and after treatment but have not made complete recoveries. Only one failed to respond favorably.

One schizophrenic of 6 treated made substantial physical gains, remains generally better and has adjusted his life at a considerably lower level, but is working steadily. Definite stimulation and animation were evident in all of the schizophrenics treated, but in 5 of these patients the reaction was not of constructive nature. These 5 subsided into passive states after the treatment was discontinued.